

SCIENCE

VOL. 87

FRIDAY, MAY 13, 1938

No. 2263

The National Academy of Sciences:

Address of the President: PROFESSOR FRANK R. LILLIE 421

Presentation of the Agassiz and the Public Welfare Medals 423

Abstracts of Papers 425

Scientific Events:

The Mount Evans Laboratory; Grants Awarded by the American Philosophical Society; Medals of the Franklin Institute. Recent Deaths 431

Scientific Notes and News 434

Discussion:

Attendance at Scientific Meetings and Membership Population Center: DR. F. M. WADLEY. Studies in the Potassium Metabolism of the Animal Body by Means of Its Artificial Radioactive Isotope: PROFESSOR DAVID M. GREENBERG and OTHERS. Fossil Algae from the Salem Limestone of Indiana: DR. ROBERT R. SHROCK. The Treatment of "Sniffles" in the Rat with Sulfanilamide: PROFESSOR NORMAN R. F. MAIER 437

Special Articles:

Effect of Oxygen Light and Lactoflavin on the Oxidation of Vitamin C in Milk: DR. DAVID B. HAND, PROFESSOR E. S. GUTHRIE and PROFESSOR PAUL F. SHARP. The Mode of Action of Sulfanil-

amide and Prontosil: ROBERT FINKELSTEIN and DR. JORGEN M. BIRKELAND. Increase in Vitamin A Activity of Corn Caused by Doubling the Number of Chromosomes: DR. L. F. RANDOLPH and DR. DAVID B. HAND 439

Scientific Apparatus and Laboratory Methods:

Simplified Schaeffer Spore Stain: GERALD K. ASHBY. A Method for Fixing and Staining Earthworms: DR. ELTON C. COCKE. Grass Volume Tables for Determining Range Utilization: TOM LOMMASSON and CHANDLER JENSEN 443

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa.

Garrison, N. Y.

Annual Subscription, \$6.00

Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE NATIONAL ACADEMY OF SCIENCES*

ADDRESS OF THE PRESIDENT¹

THIS year marks the seventy-fifth anniversary of the founding of the National Academy of Sciences. No special celebration has been set for the completion of three quarters of a century of corporate existence, such as was held at the completion of the first half century in 1913, and will, I presume, be repeated at the century mark twenty-five years from now.

The semi-centennial meeting was a gala occasion spread over three days; it was opened by an address of welcome by the president of the academy, Ira T. Remsen, followed on the morning of the first day by addresses by President Arthur T. Hadley of Yale on "The Relation of Science to Higher Education in America," by Dr. Arthur Schuster, secretary of the Royal Society of London, on "International Cooperation in Research," and in the afternoon by our recently deeply lamented and always highly honored fellow member, George E. Hale, on "The Earth and Sun as Magnets." In the evening the regents and secretary of the Smithsonian Institution entertained the mem-

* Meeting at Washington, D. C., April 25, 26 and 27.

bers and guests of the academy at a reception. On the second day, in the morning, Dr. Theodor Boveri, of the University of Wurzburg, spoke "On the Material Basis of Heredity," and Dr. J. C. Kapteyn, director of the Astronomical Laboratory of the University of Groningen, delivered an address on "The Structure of the Universe." In the afternoon a reception was held at the White House, during which the President of the United States presented medals of the academy to Professor Kapteyn, to his Excellency the Ambassador from France for transmission to the recipient, Henri Deslandres of Mendon, to his Excellency the Minister from Norway for transmission to the recipient, Johan Hjort, and finally to our fellow member, Dr. R. A. Millikan, at that time of the University of Chicago.

On the evening of that day the trustees of the Carnegie Institution of Washington tendered a reception to the members of the academy and invited guests. On the evening of the third day there was a dinner at the New Willard Hotel with after-dinner speeches by the Vice-President of the United States, the Honorable Thomas R. Marshall, by the British Ambassador, the

Right Honorable James Bryce, by the Nestor of the academy, Dr. Silas Weir Mitchell, by the president of the American Philosophical Society, oldest of American scientific societies, Dr. W. W. Keen, and by Senator Theodore E. Burton, of Ohio. The record states that the meeting adjourned at 11:40 P.M.; but if I am any judge of speakers, I am sure there was not a dull moment throughout.

I hope that the centennial celebration may be held under equally auspicious international conditions, though I am afraid that some of us, including a few who missed also the first occasion, may not be able to be present. Midway between the two events we carry on.

There were many interesting things said at the semi-centennial anniversary. Dr. Remsen reviewed the work that the academy had done for the government since its incorporation and, among other things, called attention to the fact that in the Sundry Civil Act of May 27, 1908, it was provided:

SEC. 8. The National Academy of Sciences is required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character, and all chemical, testing, and experimental laboratories, and to report to Congress as soon thereafter as may be practicable a plan for consolidating such surveys, chemical, testing, and experimental laboratories, so as to effectually prevent duplication of work and reduce expenditures without detriment to the public service.²

He relates that a committee was promptly appointed, and that committee gave serious and prolonged attention to the subject. It submitted an excellent report to the academy, which was thereupon transmitted by the president of the academy to the Speaker of the House of Representatives and the presiding officer of the Senate. What happened next? President Remsen answered: "That report seems to have been promptly pigeonholed."

One of the reasons for this treatment was undoubtedly that the committee did not consider it wise to make detailed recommendations for changes, in view of the impossibility of meting out equity and efficiency in our report. Instead they advised the establishment by Congress of a permanent board to meet at stated intervals in each year "for the consideration of all questions of the inauguration, the continuance, and the interrelation of the various branches of governmental scientific work." Thirty years after, I am pleased to note that this is the direction in which this still unsettled problem seems to be tending.

The British ambassador spoke of the charms of the scientific life: "It is the man of science who has the really happy life. He is engaged in the discovery of

truth and nothing but truth. The applause of the multitude is nothing to him." After illustrating, he remarked, "In these things, friends, there are elements of pleasure and delight, elements also of independence, which I think no other profession can equal." He continued, "I was tempted to add one other charm which your life has. It is the charm of poverty."

Dr. Mitchell was the oldest living member of the academy at that time; he was elected to the academy in 1865, and died a few months after this speech was delivered. His speech was written, for, as he said, he "was well aware of the treachery of the tongue, and much preferred the loyalty of the pen." He reflected:

Between the mere words of our record—*elected—deceased*—you, who are familiar with our history, may read much that is written clear on the roll of scientific achievement. . . .

Here are they to whom, from the depths of space, were whispered in the night watches its long hidden secrets. There too are those who, in the silence of the laboratory, rejoiced in the fertile marriage of the elements, or they who, like confessors, heard from dead bones or rock or flower the immeasurable history of the silent ages of earth. . . .

I remember once that, at my table, some one asked that ever happy naturalist, Joseph Leidy, if he were never tired of life. "Tired!" he said, "Not so long as there is an undescribed intestinal worm, or the riddle of a fossil bone, or a rhizopod new to me."

His memory went back to a meeting of the academy in 1866 with Professor Henry in the chair and Benjamin Peirce, Wolcott Gibbs, Gould, Louis Agassiz, J. H. C. Coffin and a few others to the number of about fifteen present.

The president of the American Philosophical Society, Dr. W. W. Keen, also was present and brought the greetings of the oldest scientific society in America, inaugurated by Benjamin Franklin in 1727. Speaking with wit and vigor, as always, he recalled that of the fifty original members of the academy forty-one were already members of the American Philosophical Society, and that this community of membership had continued to exist. "Our two co-ordinate societies move on, hand in hand and heart to heart in loyal co-operation, for science knows no boundaries, geographical, political or linguistic"—a statement and a wish and a hope that we heartily endorse.

And so the fiftieth anniversary celebration of the National Academy of Sciences drew to its close.

You will note the emphasis on science as "an imaginative reading the universe"³ in all this. Since then we have come far. The next year, 1914, witnessed our rude awakening from dreams of peace. The role of the academy as scientific adviser to the government immediately assumed major importance. Events

³ Arthur Symons, "Studies in Prose and Verse," 1914

² National Academy of Sciences, anniversary meeting, president's address, page 6.

moved rapidly, and in 1916 the National Research Council was organized by the academy under its Congressional charter as its agency, at the request of President Wilson, as a measure of national preparedness. In 1918 the status of the National Research Council was made permanent and its functions broadened at the request of President Wilson. It established and maintained divisions for continuing contact with research and education in all the sciences, with medicine, agriculture, industry and the federal government. Subsequently relations with the federal government were strengthened by the Science Advisory Board, and by its successor, the Government Relations and Science Advisory Committee of the academy. At the request of Secretary Ickes three members of the academy have been appointed and serve on the Science Committee of the National Resources Committee.

In all this you will note the steady growth of consciousness of social and political responsibility that attaches to scientific leadership in our times. I venture that we still love best, however, the imaginative reading of the universe as the most ideal aim of science, and in the long run the most rewarding also in a social sense.

I hardly know what to say of our foreign relations in general since 1913; certainly it would be difficult at this time to duplicate the international galaxy of the semi-centennial celebration; but if there have been clouds in some quarters obscuring parts of the galaxy, clear skies have continued to favor us in others. There is time for only one allusion. The Royal Society of London was the model after which the American Philosophical Society was patterned; if we remind ourselves of Dr. Keen's statement that four fifths of our original membership was derived from that source, a relationship of sorts must be postulated between our academy and the Royal Society. It may be of interest to remind ourselves how closely the origins of scientific organization in America were associated with the Royal Society, the roots of which trace back to 1645, though incorporated in the reign of King Charles II in 1662. During the next century many Americans, as subjects of Great Britain, were elected fellows of the Royal Society, from New England, Pennsylvania, Virginia and the Carolinas. Among them was Benjamin Franklin. In 1727 in Philadelphia, at the age of 21, he gathered scientific men around him in an informal "Junto," and in 1743 formally organized the American Philosophical Society.

After the American revolution I assume that the membership of American citizens as fellows of the Royal Society terminated. But a new relationship began as early as 1788 in the election of James Bowdoin as the first "foreign" American member. At the present time there is a considerable number of American foreign members who are also members of

the National Academy and, reciprocally, at least an equal number of members of the Royal Society who are foreign associates of our academy.

A recent fertile union of ideas among officers of our respective organizations has resulted in the birth of the Pilgrim Trust Lectureship. Under the terms of this relationship it is agreed, on the initiation of the Royal Society, that a Pilgrim Trust lecturer shall be appointed annually: in alternate years an American scientific man to be appointed by the Royal Society to give the lecture in London, and a representative of British scientific men to be appointed by the academy to give the lecture in Washington. This arrangement is supported by a grant of 250 guineas per year for a period of six years by the Pilgrim Trust. I am happy to announce that the Royal Society has appointed as the first Pilgrim Trust lecturer our fellow member, Dr. Irving Langmuir, to speak in London in December of this year.

This very welcome consummation has also been the occasion of renewal of pledges of mutual hospitality to our respective members in London and in Washington. The president of the Royal Society alluded most cordially to this arrangement in his anniversary address last November. We join with him in the wish and expectation that science, which stands apart from all nationalism, may become an increasingly strong bond between the nations of the earth.

FRANK R. LILLIE

UNIVERSITY OF CHICAGO

PRESENTATION OF THE AGASSIZ MEDAL FOR OCEANOGRAPHY TO EDGAR JOHNSON ALLEN

WHAT an association of great names of explorers of the ocean! Alexander Agassiz, Swiss-born American, great son of a great father, explorer of life in all the oceans, president of the National Academy of Sciences from 1901 to 1907, foreign secretary, 1891 to 1901 and 1908 to his death in 1910, by his will left to the academy \$50,000 to establish the Agassiz Fund.

Sir John Murray, Scot-born cosmopolitan, naturalist on the *Challenger* expedition of 1872-1876, which has been called "the most momentous geographic undertaking since the voyages of Columbus and Magellan," editor of the "Challenger Reports" consisting of 52 monumental volumes, explorer of the North Atlantic together with Johan Hjort and coauthor with him of "The Depths of the Ocean."

I recall his humorous and salty address at the annual dinner of the academy in 1911 and his gift of \$6,000 to provide for an award of a gold medal to be named in honor of his friend Alexander Agassiz and to be conferred "for original contributions to the science of oceanography."

Previous recipients of this medal have been:

- 1913 Johan Hjort of Norway
- 1918 Albert 1st, Prince of Monaco
- 1920 Charles D. Sigsbee, Rear Admiral, U. S. N.
- 1924 Otto Sven Petterssen
- 1926 Vilhelm Bjerknes
- 1927 Max Weber
- 1928 V. Walfrid Ekman
- 1929 J. Stanley Gardiner
- 1930 Johannes Schmidt
- 1931 Henry Bryant Bigelow
- 1932 Albert Defant
- 1933 Bjorn Helland-Hansen
- 1934 Haakon Hasberg Gran
- 1935 T. Wayland Vaughan
- 1936 Martin Knudsen

The committee on the award of the Agassiz Medal presents for that honor this year:

Edgar Johnson Allen, D.Sc., LL.D., F.R.S., for forty-two years the director of the Laboratory of the Marine Biological Association of Great Britain, at Plymouth, England. Dr. Allen has been in a very real sense the creator of this laboratory, which is one of the most important in the world. A British colleague has written that "it was universally regarded as a 'white elephant' when Dr. Allen took the directorship and turned it into a highly efficient research institution." In 1902 the Plymouth Laboratory was placed in charge of the British work on the International Commission for the Exploration of the Sea with Dr. Allen in charge of investigations. These investigations have been carried on there ever since and include studies on hydrography, meteorology, currents, plankton and other marine organisms. By means of these studies the circulation of oceanic waters in the English Channel and North Sea have been charted, and the movements of swarms of plankton and their relation to food fishes have been determined.

Much of Dr. Allen's own work in this program is embodied in the publications of his associates, for his wide knowledge, sound judgment and especially his sympathetic cooperation are praised by all who know him. His own most important publications may be classed in six different but related fields; namely, (1) The histology, physiology and embryology of Crustacea and Annelida; (2) the fauna and bottom deposits of English Channel Estuaries; (3) the culture of marine diatoms in artificial sea water and the quantitative study of plankton; (4) Mendelian studies of the eye pigments of Gammarus; (5) food from the sea; the connection between mackerel and sunshine; the age of fishes and the rate at which they grow; (6) the progression of life in the sea; origin of adaptations; the science of the sea.

For his contributions to oceanography in the creation and wise direction of the Plymouth Laboratory; for his unselfish cooperation with hundreds of investigators at the laboratory for the past forty-two years;

for his active work in connection with the International Commission for the Exploration of the Sea; for his direct contributions to the study of the life of the sea and its relation to human welfare, the committee on the Agassiz Medal takes particular pleasure in recommending for the award at this meeting a friend of Sir John Murray and Alexander Agassiz—Dr. Edgar Johnson Allen.

EDWIN G. CONKLIN

In the absence of Dr. Johnson, the medal was received by Leander McCormick Goodhart, Esq., of the British Embassy.

PRESENTATION OF THE PUBLIC WELFARE MEDAL TO WILLIS RODNEY WHITNEY

My great joy in presenting to you for honor my friend, idol and former director is tempered with a sense of inadequacy on my part. Poor lame words can not portray great qualities; they connote only the common.

Dr. Whitney is well known as a scientist, and you have already honored him as such. He has made outstanding contributions to human welfare in the field of electric lighting, and in the use of high-frequency electric currents for curing diseases such as paresis, arthritis and bursitis.

His greatest contribution, however, is as organizer and director of scientific research. Not the common organizer. The very term does him injustice. His organization was a growth rather than a creation. It grew so gradually that it is difficult to give any date when it became an organization, except the date, November, 1900, when the M. I. T. professor began sharing his time with General Electric, spending two days each week at Schenectady.

Nor was he an ordinary director, of the kind who keeps a large number of men busy by telling each what to do. Dr. Whitney never told anybody what to do. His leadership was more by example and inspiration than by precept. It would be unfair to him not to acknowledge that he originated a large fraction of the projects which he so generously credited to others; but he seldom if ever assigned these problems. I never was able to get him to tell me or even advise me what to do. His method was suggestion. On his daily rounds of the laboratory he always had some new suggestion, which he continued to peddle until some one became enthusiastic and *asked permission* to work on it. The executive who tells a hundred assistants what to do achieves the efficient goal of providing a hundred pairs of hands for one brain. Dr. Whitney had a hundred brains working together.

A characteristic feature of Dr. Whitney's direction was his receptiveness to new ideas; yet no one was harder to fool. He seldom fired anybody, yet it would be hard to find a group with fewer drones. He never

talked about good will and cooperation, yet these qualities grew and flourished under his leadership. Most important of all was his faith in the value of fundamental research. When he asked me to join the laboratory I hesitated, telling him that I had never done anything practical in my life and mistrusted my ability to do so. "Don't worry about the practical part," he said, "that is my job. You go ahead and work on whatever you want to, and leave the rest to me." He lived up to his word. He himself tells the story of how he had to defend Langmuir, who had been working four years with no visible results. "Leave Langmuir alone," he said, "he is getting valuable data." The next year Langmuir brought out the gas-filled lamp, the following year the law of space-charge and the radio tube.

The laboratory that has grown up under his leadership is still small, scarcely 300 men. Its influence for public welfare is not so much *their* contributions to science and industry, as *his* contribution, as a pioneer in industrial research, in demonstrating what was by no means obvious, that pure research can be successfully carried on in an industrial laboratory, with profit and untold benefit to mankind.

For this eminence in the application of science to public welfare I commend to you Dr. Willis Rodney Whitney, pioneer of industrial research.

A. W. HULL

RESPONSE BY THE MEDALIST

I HIGHLY appreciate the honor you bestow in presenting to me this Marcellus Hartley Public Welfare Medal.

I am encouraged first to express a personal thought. I always lacked somewhat general civic virtue. I never wanted to be a mayor or a major. I usually quieted my critical conscience so as to concentrate selfishly on my attractive industrial job. Therefore, I greatly appreciate those plain words, "public service." Every one at heart wants to be of public service and all industries must hope to be. But nothing nicer could happen to an employee of an industry than such a reward from such a source.

Actually, however, I have been only a part of a machine or assembly line to which the reward more properly belongs. However, as representing a living active group of research men, I gratefully accept this token.

But I want to extend the explanations much further, back to one who did so much to encourage the use of new scientific truth in public service. While Bloody Queen Mary and Queen Elizabeth were burning at the stake countless persistent leaders of good and pure thought (Mary, the Protestants, and Elizabeth, the Catholics), Francis Bacon was devoting a long and useful life to advancing clearer conceptions of truth.

It occurred to him that to learn with certainty how many angels could stand on the point of a pin, careful experiments and observations were necessary. Mary, Elizabeth and Bacon were each righteously and terribly in earnest, but their techniques greatly differed. Bacon advocated experiment, for there had accumulated an infinite ignorance about the truly infinite creation. He was so logical, so sincerely inquisitive and so persistent that societies for research and academies of science quite displaced the old Inquisitions. Bacon made it very plain that perpetual improvement in public welfare was only obtainable through honest, industrious interrogation of nature. We call that research.

In our particular research-group our duty is to help counteract the effects of obsolescence of electrical products and prevent interruption of employment of large groups by actively aiming at new electrical unknowns.

In such work we also found, somewhat as a by-product, that our research men could contribute to growing science by publishing their results. They have now published about one thousand scientific articles. These, I like to feel, are contributing thus to general knowledge and public welfare.

W. R. WHITNEY

ABSTRACTS OF PAPERS

Distribution of galaxies in the anti-center region:
HARLOW SHAPLEY.

Solar corona photography: IRVINE C. GARDNER (introduced by W. W. Coblentz). The lenses of extremely long focal length (60 to 100 feet) and small relative aperture (1/80 to 1/200) that have been commonly employed for corona photography have two fundamental disadvantages; the image is larger than is necessary in order to insure that all resolved detail shall be recorded by the photographic emulsion; and the lens works too slowly to permit the outer portions of the corona to be photographed during an eclipse of short duration. A lens for eclipse photography has been specially designed and constructed at the National Bureau of Standards from optical glass made at the bureau's own glass plant. The lens is composed of four components, widely separated, has a clear aperture of nine inches and is corrected for all the third order aberrations over a large field, a feature impossible with the two-component (or three-component apochromat) telescope objective commonly used for eclipse photography. The equivalent focal length is approximately 19 feet and, as a by-product of the design, the lens has telephoto properties so that the overall length of the camera is only 14 feet. The camera is designed to permit focusing in the laboratory and a precise reproduction of the laboratory adjustment without further focusing at the eclipse station. The mount is designed to give extreme portability and to enable the camera to be rapidly erected by a small group of men. Consequently the use of the instrument does not require the occupation of the

eclipse site many weeks in advance of the eclipse, as has been the case with the larger corona cameras. This camera has been used at the eclipse of 1936 in Asiatic Russia under the sponsorship of the National Bureau of Standards and the National Geographic Society and at the eclipse of 1937 at Canton Island under the sponsorship of the National Bureau of Standards and the National Geographic Society-United States Navy Expedition. Satisfactory corona photographs were obtained at both eclipses in black and white and by color processes. These will be shown by projection.

Photometric measurements at the total eclipse of June 8, 1937: F. K. RICHTMYER. By means of several photoelectric cell photometers of different sensitivity, measures were made of the total light from the solar corona and this light was compared in intensity with the light of the full moon at the same altitude two weeks previously. Additional measurements were made on the "daylight" illumination during totality; that is to say, the illumination produced by corona plus full sky. The total light from the corona was found to be 53 per cent. of the light of the full moon at the same altitude, in substantial agreement with most of recent measurements. The "daylight" illumination was some ten times that produced by the corona alone, indicating that the general illumination during an eclipse is due to the infiltration of sunlight from outside the shadow. This is in entire agreement with the observation that the general illumination increased rapidly as totality progresses and just at the end of totality was some ten times its value at the beginning of totality.

Propagation of wave-packets in a stratified doubly-refracting ionosphere: H. G. BOOKER (introduced by F. E. Wright). The magneto-ionic theory in the form now in use is only suitable for investigating vertical propagation in the ionosphere. The theory is generalized so as to be capable of describing oblique propagation of a magneto-ionic component through the ionosphere without using a refractive index which depends in a complicated way upon an unknown angle of refraction. The fundamental formula of the oblique-incidence magneto-ionic theory is an algebraic quartic equation for a quantity q which depends upon the prescribed angle of incidence and which at vertical incidence becomes identical with the well-known refractive index. The four roots of the quartic equation for q correspond to the upgoing ordinary wave, the upgoing extraordinary wave, the downcoming ordinary wave and the downcoming extraordinary wave. The level in the ionosphere where the individual wave-crests are moving horizontally across a characteristically polarized wave-packet is given by the condition $q=0$, which is equivalent to putting the angle of refraction equal to $\pi/2$ in Snell's law. But the level of reflection of the magneto-ionic component is the level where the wave-packet as a whole is traveling horizontally, and is given by the condition that the root of the quartic equation for q corresponding to the upgoing magneto-ionic component should be equal to a root corresponding to a downcoming magneto-ionic component. The critical electron-density required for reflection of a magneto-

ionic component can easily be as much as 25 per cent. in excess of the erroneous value which would be calculated by putting the angle of refraction equal to $\pi/2$ in Snell's law.

Diffraction gratings for astrophysical research: R. W. WOOD. Large plane gratings on aluminized pyrex blanks have been ruled for the Mount Wilson spectrograph of the 100-inch telescope, and for certain spectrographs of new design in process of construction at the Harvard Observatory. One of these throws 85 per cent. of yellow light into the first order spectrum (in comparison to the reflection from an unruled aluminum mirror). Complete measurements have been made for all wave-lengths, all orders of spectra, at all angles of incidence, with a photonic cell and wall galvanometer in the case of an 8-inch grating (15,000 lines to the inch) which concentrates over 75 per cent. of the light of the visible spectrum in the second order spectrum. This grating was ruled for the 100-inch telescope.

Preliminary report on a radiometric method of measuring ultra-violet solar intensities in the stratosphere: W. W. COBLENTZ and R. STAIR. With the aid of a grant from the Joseph Henry Fund and in cooperation with the radio section of the Bureau of Standards, during the past summer tests were made of a new radiometric method of measuring the spectral quality and total intensity of ultra-violet solar radiation at various altitudes above the earth's surface. The radiometric apparatus consists of a photoelectric cell and filter radiometer, combined with an audio-frequency generator and radio transmitter, transported aloft by means of unmanned balloons. The response of the photoelectric cell to ultra-violet radiation modulates the radio-frequency wave. The height of the balloons is indicated by a radio barograph. The radio signals giving the altitude of the apparatus and the ultra-violet intensities are received and recorded graphically at a ground station. Although altitudes up to 24 km were attained, owing to electrical interference and other difficulties strictly quantitative data were obtained only to a height of about 19 km. Below 14 km the ultra-violet transmissions of the filters remained fairly constant, indicating but little ozone below this elevation. Between 14 and 19 km the filters show a continuous decrease in transmission (a selective increase in intensity of ultra-violet of the shortest wave-lengths, imperceptible at sea-level) with increase in elevation indicating that at a height of 19 km the apparatus had passed through an appreciable portion of the ozone layer, variously estimated at 15 to 30 per cent. of the superposed ozone. The observation of practically no ozone below the 14 km level and a penetration of 15 per cent. of the layer, at a height of 19 km is in good agreement with previous explorations (the *Explorer* in 1934) taking into consideration the latitude of the observing station and the time of the year. From the results obtained the method appears highly promising for securing information on ultra-violet intensities and ozone distribution in the stratosphere. The work is therefore being undertaken anew, with improved apparatus.

The extension of measurements on sea-level cosmic-ray intensities to the North Magnetic Pole: R. A. MILLIKAN and H. VICTOR NEHER. Through the kindness of Dr. H. Carmichael, we sent a Neher recording electroscope on the Wordie Arctic Expedition of the summer of 1937. Within the limits of the observed daily fluctuations, never more than 2 per cent., we find no variation between magnetic latitudes 64° and 90° . Combining this with 1931 Millikan expedition from Pasadena to Churchill (mag. lat. $60^\circ 30'$), we conclude that within the same limits there is no latitude variation between Pasadena (mag. lat. 41°) and the North Magnetic Pole.

New light on the nature and origin of the incoming cosmic rays: I. S. BOWEN, R. A. MILLIKAN and H. VICTOR NEHER. As a result of measurements made in four different latitudes with Neher recording electroscopes sent in balloon flights which reached a minimum pressure of but 9.9 mm of mercury (practically to the top of the atmosphere) we have found (1) that the curve of energy distribution of the incoming cosmic-ray electrons has a maximum at about 6 billion electron-volts; (2) that this curve falls to less than one third its maximum value both at an energy of 1 billion e-volts and at 20 billion e-volts; (3) that this type of banded structure renders it unlikely that the cosmic rays originate in portions of the universe in which matter exists in appreciable densities; and (4) that the observed energies of the cosmic rays are about those to be expected if the abundant elements have the capacity to transform their mass-energy completely into cosmic ray-energy.

The binding energies of the heavy nuclei: A. J. DEMPSTER. The exact comparisons of the masses of the various atoms show that they diverge by different amounts from integral values when referred to the lightest oxygen isotope at mass 16. This divergence divided by the nearest integer is called the packing fraction, and is connected with the binding energy of the nuclei of the atoms. The packing fractions for forty nuclei have been compared and a curve drawn to show how the binding energy varies for the different elements. The curve suggests a reason for the abrupt cessation of radioactivity with the element lead. The energy emitted in radioactive disintegration has an equivalent mass. The atomic weights of several elements as calculated from the isotopic structure agree better with the chemical determinations when this packing fraction curve is used.

An experimental study of the rate of a moving atomic clock: HERBERT E. IVES. According to the theory of the relation between matter and the stagnant luminiferous ether, as developed by Larmor and Lorentz, a moving clock should assume a slower rate, proportional to the square of the ratio of its velocity to the velocity of light. It was pointed out by Einstein in 1907 that the newly discovered Doppler effect in canal rays offered a means for making a test of this prediction. This experimental test, the crucial nature of which has been emphasized repeatedly in the last thirty years (under the designation of the "Transverse Doppler Effect") has not heretofore been performed. It has been commonly considered as

beyond experimental practicability, chiefly on the ground that the moving canal rays are not homogeneous in velocity, the "displaced" line is too diffuse for sufficiently exact measurement. This objection has recently been removed, due to the development, by Dempster, of a design of canal ray tube which gives displaced lines of a sharpness comparable with the undisplaced. In this form of tube the positive ions produced behind the electrode are accelerated between two slightly separated pierced plates between which a high potential difference exists. The present investigation is an experimental test of the Larmor-Lorentz prediction, using canal ray tubes of the Dempster type. The hydrogen line 4861 A.U. has been used, observations being made by means of a plane grating of metal on glass of 15,000 lines to the inch, made by Professor R. W. Wood, which, in conjunction with two 5-inch diameter, 5-foot focus telescope objectives formed a sufficiently powerful spectrograph for the purpose. By means of a small concave mirror mounted on the pierced electrodes, end-on observation gave, on one plate, the displaced lines due to motion toward and away from the spectrograph slit. The apparatus was arranged to turn in any desired direction in the horizontal plane. Observations were made over a range of voltages from 7,000 to 19,000, using the displaced H_2 and H_3 lines. At the higher voltage, for H_2 the directly viewed and reflected displaced lines should, according to the theory, have their common center of gravity shifted, with respect to the undisplaced line, by approximately 0.05 A.U. The experiment shows the predicted shifts, which are independent of the orientation of the apparatus, and agree, within the errors of measurement, with the values indicated by the theory. On the assumption of a stagnant ether, this experiment, taken in conjunction with the Kennedy-Thorndike experiment, establishes the physical reality of both the Larmor-Lorentz variation of clock rate, and the Fitzgerald contraction. It is distinguished from the Michelson-Morley and other previous optical experiments by the fact that it yields a positive instead of a null effect.

Intensities of electronic transitions in molecular spectra: ROBERT S. MULLIKEN. Quantum-mechanical calculations on electronic transitions in diatomic molecules yield a useful classification of such transitions in respect to intensities. *Parallel-type transitions* ($\Delta\Lambda = 0$) in which an unexcited molecule goes to an excited state whose wave function is *strongly* or *largely ionic* in character should have very high intensity (examples, ultraviolet band-system of I_2 near λ 2000, Schumann-Runge system of O_2 , Lyman system of H_2). The same prediction of high intensity follows, using either the atomic-orbital or the molecular-orbital method of approximation; the united-atom-orbital approximation, so far as it is applicable, also makes similar predictions. In terms of molecular orbitals, parallel-type transitions of the kind just discussed always involve the passage of an electron from a bonding to the corresponding antibonding orbital, and it may be predicted that such a passage (or its converse) should in general give very strong absorption (or emission). On the other hand, *perpendicular-type*

transitions ($\Delta\Lambda = \pm 1$) are less likely to have high intensity and can have very low intensity, especially in loosely bound molecules having only p valence electrons, of which the halogen molecules are good examples. Application to the visible halogen spectra of the foregoing results on parallel-type and perpendicular-type transitions completes a satisfactory explanation of these rather anomalous spectra. Under suitable circumstances, namely, when an electron in an s or in an $s-p$ hybrid orbital is involved, perpendicular-type transitions may be expected to have moderate or high intensity. The foregoing results and their generalization to electronic spectra of polyatomic molecules should have considerable value for the systematic understanding of such spectra. The preceding discussion does not apply to the Rydberg series regions of molecular spectra, but only to the longer wave-length or sub-Rydberg spectra which lie in the visible and the more or less near ultra-violet. It should, however, be noticed that a sharp distinction can not always be drawn between sub-Rydberg and Rydberg regions; frequently a strong transition in the borderland of the two regions can be assigned more or less justifiably to either one or to both of them (example, Lyman band-system of H_2). In the true Rydberg series spectra, intensity relations similar on the whole to those in atomic spectra are expected, but interesting special features are also predicted.

A class of orthogonal functions on plane curves: DUNHAM JACKSON. The notion of a system of polynomials in one variable orthogonal with respect to an arbitrary weight function is modified and in a sense generalized by substitution of trigonometric sums for the polynomials. Another generalization results from the consideration of polynomials in two variables orthogonal with respect to integration along an algebraic curve in the plane of the variables. These two ideas are combined in the present paper to define a still broader class of orthogonal functions, in the study of which attention is given both to formal properties and to questions of convergence of the resulting developments in series.

The geometry of motions and whirls: EDWARD KASNER. Translations and rotations in a plane generate the three-parameter group of rigid motions M_3 . If we operate on the opulence of lineal elements by slides and turns we generate an isomorphic group W_3 , the group of whirls. This may be termed the *skating group*—think of sliding and pivoting on the ice. Together M_3 and W_3 generate a new six-parameter group G_6 . We obtain this group by skating on a moving floor. This fundamental group is employed as the basis of a new type of geometry. In particular the invariants of differential elements, turbines, flat fields and quadric fields (simple differential equations) are determined. Quadratic fields are classified into seven types.

Symbolic dynamics: MARSTON MORSE and ARNOLD HEDLUND. The classical theory of dynamical systems as developed by Poincaré, Birkhoff, Hadamard and more recently by the authors, make use of the methods of differential geometry and in the last years of a powerful symbolic analysis. The symbols used are unending se-

quences whose terms are taken from a finite set of generating symbols. These symbols represent the typological or group theoretic operations which form the basis of the dynamics. In the past the symbolic aspects of dynamics and the differential aspects have been interwoven so as to be highly dependent. The authors find it possible to develop a symbolic dynamics independent of the theory of differential equations. The basic questions of recurrence and transitivity must be met on the basis in the first instance. Following this symbolic analysis suitable hypotheses concerning the degree of instability of the dynamical system enable one to carry over the symbolic theorems to ordinary dynamics. Having resolved dynamics into these two aspects various new theorems are obtained both on the symbolic side and on the side of the theory of space forms bearing transitive geodesics.

Pentagons formed by seven planes in projective space: H. S. WHITE. When seven planes lie in the space of projective geometry, no more than three meeting in any point, they divide that space into forty-two convex polyhedra, or not more than nine species, with convex polyhedrons for faces. The problem arises, to describe the system of polyhedra, in all its possible varieties, numerically and tactically. That problem has unique solution in the case of four, five or six planes. For seven, many solutions being possible, it is proposed to attack first a simplified problem, neglecting polyhedra whose faces do not include pentagons or hexagons. The investigation has been conducted experimentally with a minimum of deductive reasoning, and the results are presented in terms of merely schematic diagrams. But these are believed to indicate sufficiently convenient lines for abstract discussion.

New or modified chlorophylls resulting from a recessive pale mutation in Datura: O. L. INMAN and A. F. BLAKESLEE (introduced by C. F. Kettering). Pale-7 is a recessive character bringing about a reduction in green color in leaves of *Datura stramonium*. The gene is a recessive and was induced by x-rays treatment of seeds. It has been located in the 1-half of the 1.2 chromosome. When heterozygous Pale-7 has no observable effect upon either the amount of chlorophyll or upon the spectrum. In the homozygous condition, however, an acetone leaf extract transferred to ether gives an absorption spectrum which is definitely different from the normal chlorophyll $a + b$ mixture spectrum in the number and relative positions of the absorption bands. This is true for the crude extract and for an extract partially purified by chromatographic fractionation on an inulin column and then on a sugar column. When acid is added to the ether solution, the formation of pheophytin by the substitution of two hydrogen atoms for the magnesium atom in the chlorophyll molecule takes place. The pheophytins are also different from the normal pheophytins in their absorption spectra. Up to now insufficient material has been available to complete the purification and analysis of the product. Until this is done, the spectra shift and other possible differences cannot be adequately explained. So far as the authors are

ware this is the first instance where different chlorophylls have been found in green plants.

Thiamin and growth of Pythium Butleri: WILLIAM J. ROBBINS and FREDERICK KAVANAGH (introduced by B. O. Dodge). Previous work has shown that some fungi form thiamin from the elementary materials of the medium, while others are unable to do so. Of those which form thiamin some are unaffected by its addition to the medium, while the growth of others is more or less inhibited. Amongst those organisms which require for growth the addition of thiamin to the medium there are some which are incapable of synthesizing either of the thiamin intermediates; some which form one or the other; some which lack the ability to form thiamin even if both intermediates are supplied. *Pythium Butleri* appears to differ from all the types enumerated above. It resembles some of them in its ability to grow in a suitable synthetic medium which lacks any organic growth supplement. It differs in responding favorably to the addition of thiamin to the medium. Apparently *P. Butleri* synthesizes thiamin from the elementary materials in the medium but in amounts inadequate for maximum growth. Furthermore, the composition of the medium, particularly its concentration, injuriously affects the growth of this organism; the inhibition of growth in the more concentrated solutions appears to be related to a reduction in the amount of thiamin produced by the organism. Our results suggest further that *P. Butleri* forms more of the vitamin thiazole than of the pyrimidine intermediate, and in a liquid medium containing mineral salts and sugar the pyrimidine synthesized by the organism is the factor limiting its growth. We have found that inorganic salts are a satisfactory source of nitrogen for this fungus. These observations confirm the importance of thiamin as a growth substance for plants; they show further that the amount formed may be a limiting factor in the growth of an organism and that cultural conditions which inhibit growth may be effective because of their influence on thiamin formation.

The distribution of electric potential on the external surface of single cells: E. J. LUND (introduced by H. S. Jennings). When the distribution of electric potentials between microscopic areas on the external surface of living Pithophora and Nitella cells were carefully measured and mapped out by a new method, it was found that different microscopic areas or spots on the external surface have inherent electric potentials of characteristic magnitudes. Between such spots of different potential there flows continuously local electric currents. With such electrode connections it seems evident that the internal (sap) and external solutions (tap water) are symmetrical and that the P. D. and energy source could only be located "in" the protoplasmic film separating the two solutions. The demonstration that there exists a regular distribution of increasing electric potential along the external longitudinal surface of the cell in Pithophora shows that this structurally polar cell possesses an inherent ("protoplasmic") electric polarity which is not due merely and only to differences in concentration of ions in the cell sap or external medium or both.

The characteristics of the electric polarity in these cells are similar in all general respects to those in the onion root, oat coleoptile, Chara, Douglas fir, hydroids, Elodea leaf, etc., which we have previously studied in detail. The validity of the principle of algebraic summation of electric polarities of cells in a polar tissue (root tip) has been demonstrated for the linear cell aggregate in Pithophora.

The public and the cancer problem: JAMES EWING.

The concentration of isotopes by chemical means: H. C. UREY, H. G. THODE and JOHN E. GORHAM. A 46-fold change in the ratio of the nitrogen isotopes has been effected by the use of the exchange reactions between ammonia gas and ammonium nitrate solution, using a two-stage distillation column as suggested by Urey, Huffman, Thode and Fox.¹ The first column consists of a 1-inch glass tube 40 feet in length packed with glass spirals, and the second column of a 3/8-inch glass tube 25 feet in length also packed with glass spirals. On the basis of preliminary experiments each of these was calculated to give approximately a 10-fold increase. The two columns produced 14.8 per cent. N¹⁵ in two weeks, and the concentration was continuing to rise. The transport was about 0.15 grams of N¹⁵ per 24 hours. A third section, consisting of a 3-inch glass tube 50 feet in length packed with Berl saddles, is being constructed. This should increase the transport by a factor of 10, and should increase the concentration which can be produced at the present time. The concentration of S³⁴ has been increased by the use of the 3/8-inch column. Using the exchange reaction between sulfur dioxide and sodium bisulfite solution, S³⁴ concentrates in the solution, and hence the same apparatus can be used for work on this isotope, though probably much smaller changes in concentration can be effected.

Studies in radium poisoning: the metabolic effects of ingested radium in rats: ROBLEY D. EVANS and ROBERT S. HARRIS (introduced by K. T. Compton). Relatively small doses of radium chloride were fed by mouth to 6 young male albino rats of the Wistar strain. Animals receiving 20, 35 and 70 micrograms of radium showed normal growth performance. Their bones, however, became very fragile and fractures occurred during normal handling of the animals. Fifteen months after ingestion of the radium the two animals which had received 35 micrograms and the two at 70 micrograms each developed osteogenic sarcomata. The six control animals show no such tendency. This finding parallels the well-known observation of osteogenic sarcoma in humans who have endured chronic radium poisoning for ten to fifteen years. Efforts are now being made to transplant these new bone tumors to normal animals of the Wistar strain. Quantitative studies of the radium metabolism have been made on all the animals. At the highest dosage level, 98 to 99 per cent. of the ingested radium was excreted by the animals within a few weeks after feeding. The fractional retention decreases markedly with decreasing total dosage, paralleling the new observations on human beings. The radon content of the exhaled breath of the rats represents about 50 per cent. of the total body radium, as in human beings. The average concentration of radium in the rat's

¹ *Jour. Chem. Phys.*, 5: 856-868, 1937.

skeleton is, however, several hundred times greater than the concentration required to produce osteogenic sarcoma in man.

Relationship of humidity to evaporation of sweat: EUGENE F. DU BOIS and JAMES D. HARDY. The rate of evaporation of sweat from the surface of the skin depends upon the difference in vapor pressure of the water on the skin and in the air, assuming constant air motion. The vapor pressure of the sweat may be found from the skin temperature. The vapor pressure of the atmospheric water vapor depends upon the relative humidity and the temperature. The evaporating tendency of sweat may then be computed for any humidity, and the effect of a change in humidity upon perspiration rate studied. From pure physics it is easy to see that a change from 50 per cent. to 100 per cent. relative humidity affects the evaporation rate by only 6 per cent. at 32° F. and only 20 per cent. at 60° F. At 95° F., however, such a change will cause complete cessation of evaporation of sweat. If, now, the physiological factor of the rate of sweating be taken into account a clear picture of the actual importance of this change in humidity is obtained. From 32° F. to 86° F. the quiet body has little use for sweating, so that body heat loss is affected only 1 per cent. at 32° F. and 15 per cent. at 86° F. Between 86° F. and 88° F. the importance of humidity increases enormously, and in the quiet body a change from 50 per cent. to 100 per cent. relative humidity determines the matter of comfort or fever. In a moderately active person (walking slowly), the importance of humidity in the lower range of temperature is the same as for the quiet person. However, at 78° F. the importance rises rapidly, becoming 100 per cent. at about 90° F. In a still more active person the sharp increase in importance comes at a lower temperature.

The movement of water from concentrated to dilute solutions through liquid membranes: W. J. V. OSTERHOUT and J. W. MURRAY. In certain models set up to imitate living cells the behavior of water is the opposite of what is expected, for it moves from a concentrated to a dilute solution or from a region of low to one of high activity. This apparent violation of the laws of thermodynamics may continue for months before equilibrium is attained. A movement of water from a concentrated to a dilute solution, so-called "anomalous osmosis," observed with certain solid membranes has been ascribed to the action of pores. But in our models only liquid membranes are employed and no pores exist. The evidence indicates that we have to do with a new phenomenon. The principle may be illustrated thus. Water and guaiacol (o-methoxyphenol) are shaken together until equilibrium is attained. Some of this guaiacol (for convenience called B) is placed in the bottom of a U-tube: resting on this in the left arm A and in the right arm C is some of the distilled water which has been shaken with the guaiacol. The water does not mix with the guaiacol but forms a separate phase. On adding trichloroacetic acid to A we might expect water to move from C to A, but the opposite happens. We find that water and acid move from A to B and from B to C. The higher the concentration of acid in A the greater the movement of water

into C. This is because the acid increases the solubility of water in the guaiacol phase and thus causes water to pass from A to B, but when the acid moves from B to C the solubility of water in B decreases and in consequence water goes from B to C. As the freezing point of A is lower than that of C it is evident that water moves from A, where the activity of water is low, to C, where its activity is high. The movement of water vapor through the air in an inverted U-tube above the solutions is from C to A. This appearance of "perpetual motion" can go on for months, ceasing only when A and C become identical in volume and in composition. The increase of water in C may amount to 40 per cent. or more. In view of the surprising nature of this result we thought it desirable to test it in another way, namely, by shaking A with B and then shaking B with C (in both cases the shaking was continued until equilibrium was attained). The result shows an increase of water in C which may amount to more than 400 per cent. Since in certain respects guaiacol acts like some protoplasmic surfaces it seems possible that similar phenomena may occur in living cells. Using acetone in place of trichloroacetic acid the results were somewhat similar but much less striking.

Cellular reactions in sensitization: FLORENCE R. SARTER and A. L. JOYNER. The importance of the reaction of the skin of the tuberculous animal to the injection of tuberculin has long been recognized. For a time it was thought that this sensitivity developed only through the infection; then it was found that it could be elicited with dead bacilli and quite recently it has been induced with tuberculo-protein but only with large amounts. It has now been found that tuberculo-phosphatide enhances the sensitization of guinea-pigs to tuberculo-protein. We consider that this enhancement is at least in part related to the increased cellular reaction brought about by the phosphatide in the presence of protein. The cellular reaction is a local increase in monocytes, the formation of epithelioid cells and a subsequent infiltration of the tissues with eosinophilic leucocytes. The use of two unrelated chemical fractions from the bacillus induces a type of sensitization more like that of the disease both in time and in degree than is brought about by the same amount of protein. The experiments suggest that the monocytes and epithelioid cells play a rôle in the phenomenon of sensitization.

Size of population and breeding structure in relation to evolution: SEWALL WRIGHT. Size of population plays an important rôle in evolutionary theory. The effective size (N) of the theory, may, however, differ much from the apparent size, being usually much less. N obviously refers only to the breeding population. If the numbers (N_m, N_f) of mature males and females are different, N depends mainly on the less numerous sex.

$$\left(N = \frac{4 N_m N_f}{N_m + N_f}\right).$$

The surviving offspring are likely not to be derived at random from the parental generation. With N₀ parents furnishing varying numbers (k) of gametes to a next generation of equal size ($\bar{K} = 2$),

$$N = \frac{4 N_0 - 2}{2 + \sigma_k^2}.$$

of greater probable importance in nature are cyclic variations in numbers. In a cycle of not too long a period (in generations) the effective size

$$\left(N = \frac{n}{\sum_{i=1}^n \frac{1}{N_i}} \right).$$

is controlled largely by the phase of small numbers. A small N permits random fixation of non-adaptive characters and to some extent control by mutation pressure. In a large species, restrictions on interbreeding may permit differentiation of local populations. The variance of gene frequencies (σ_q^2) takes the value $q_i(1-q_i) f$, where q_i is the mean gene frequency in the species and f is the inbreeding coefficient. In a population distributed continuously over a large area, but with mates always drawn from small groups (size N) the value of f for groups separated by n generations of ancestry or by \sqrt{n} diameters of the unit area), lies between $\frac{\Sigma}{N + \Sigma}$ and $\frac{\Sigma}{2N - \Sigma}$ where $\Sigma = \sum_{x=1}^n (1/X)$. This permits considerable fluctuating local differentiation where N is less than a few hundred but leads to approximate fixation of differences only if N is much smaller. In a species, whose range is essentially one dimensional, f has the value $\sum_{x=1}^n \sqrt{1/X}$. Differentiation increases much more rapidly with distance than in the preceding case. Another mode of attack is appropriate where the range is subdivided into partially isolated territories. As shown previously σ_q^2 here takes the form $q_i(1-q_i)/(4N_m + 1)$ where N is the effective size of the local group and m is the effective proportion of immigrants from the species as a whole. Both N and m may be much smaller than indicated by actual numbers and amounts of cross breeding with neighboring groups. If small enough, there is random non-adaptive differentiation of local groups. With small m , but not N , there is adaptive differentiation in respects related to differential conditions. These proc-

esses may be expected to be supplemented by intergroup selection such that those local groups which happen to acquire combinations of characters of more than local adaptive significance multiply relatively rapidly and supply more than their share of emigrants. The simultaneous action of partial isolation and intergroup selection should result in a more rapid evolutionary process than either isolation alone or intragroup selection alone. Splitting of species requires nearly complete isolation. In some cases (as where translocations become fixed) there is evidence of fixation against very strong selection, likely to occur (in a sexually reproducing species) only if there are numerous outlying territories in which the populations are so isolated and so liable to extinction that the lines of continuity frequently pass through single stray individuals.

The mechanism of hearing as revealed through experiment on the masking effect of thermal noise: HARVEY FLETCHER. In an electrical conductor there is a statistical variation of the electrical potential difference between its two ends, which is due to the thermal agitation of the atoms, including the electrons. This electrical noise is amplified by means of a vacuum tube amplifier and then converted into an acoustical noise by means of a telephone receiver held on the ear. When this noise is present it reduces the capability of the ear to hear other sounds. The intensity per cycle of the acoustical noise compared to the intensity of a pure tone which can just be perceived in the presence of a noise was determined experimentally using a group of observers. This relative intensity for a given frequency range was constant throughout a wide variation of intensity. However, its value does vary with the position in the frequency spectrum, and it is the amount of this variation which enables one to calculate the relation between the frequency of the tone and its position of maximum stimulation along the basilar membrane. The results of such a calculation are given and shown to be in good agreement with determinations from animal experimentation.

(To be concluded)

SCIENTIFIC EVENTS

THE MOUNT EVANS LABORATORY

THE Mt. Evans Laboratory, which is sponsored by the Massachusetts Institute of Technology and the University of Denver, will be available to research workers in the field of the sciences during the months of July, August and September. This laboratory is located on Mt. Evans (altitude 14,260 feet) which is 65 miles from Denver by automobile road.

The services rendered by the laboratory are materially enhanced by the availability of the laboratories of the University of Denver and the University of Colorado School of Medicine; stations at altitudes of 11,000, 8,000 and 7,000 feet, respectively, where one may obtain living accommodations and electric power; deep snow-fed lakes at high altitudes, which include

Summit Lake on the road to Mt. Evans five miles from the peak; mines and tunnels in and near Idaho Springs, which is at a distance of 15 miles, and the Division of Photography of the Army Air School in Denver. The greatest demand has come from workers in the field of cosmic rays, but there are many problems in science which may be studied at this altitude.

D. K. Froman and J. C. Stearns connected a Ferranti electrostatic voltmeter between a horizontal wire and ground. This wire was supported by two poles to which it was attached by porcelain insulators. The air was ionized by burning splints in tin cans which were affixed to the wire. With the wire six inches above ground the voltmeter reading varied from 0 to more than full scale reading, which was 2,500 volts.

At this altitude not only are there corona discharges from physical projections, but one quite often experiences electric discharges from the tips of his fingers or ears. The quick changes in weather, which varies from winter to summer each day, makes this an interesting location at which to make a study of the potential gradient.

Examples of other general fields of investigation in physics are those of the electrical conductivity of air, ultra-violet light and cosmic rays. The time necessary to secure data in the field of cosmic rays is materially decreased, for at this altitude the intensity of primary cosmic rays and cosmic ray showers is respectively five and ten times their intensity at sea level. The figure for showers is only approximate and may be greater than this for many particle showers. This enables the collection of data during the summer season which would require observations extending over a period of a year at sea level. In addition, intermediate altitudes, deep mines, lakes and aeroplanes are available to workers in the field of cosmic rays.

In the field of biology the laboratory offers an opportunity to study two types of problems: One, the influence of the increase of natural radiations on the biological processes; and the other, the biological effects due to the decrease of oxygen. An example of the former is the work of Dr. Victor Jollos, who used the laboratory to study the effect of cosmic primary and shower radiation on mutations in *Drosophila*. A problem in the latter field is the study of mountain sickness, which may be carried on to advantage as there are patients in great numbers; those who are summer guests at the laboratory and a large number of tourists. (The tourists are directed up another peak, and this one hike so thoroughly satisfies most of them that there is a minimum number of uninvited visitors at the laboratory.)

It is hoped that the laboratory may soon be utilized throughout the year by the department of meteorology. At the present a preliminary study of the meteorological conditions at this altitude during the summer months should be of scientific interest. Those interested in Alpine botany and nature study will be surprised and pleased at the variety of flowering plants above timber line. A region on the Mt. Evans road about 10 miles from the peak has been preserved for botanical study. While the automatic devices are taking data in the laboratory, an inviting field for research is Summit Lake, well stocked with large mountain trout which defy the efforts of all dieticians to prescribe a bait which will tempt them.

The physical plant has been described in another article.¹ If there is a growing demand for the services of the laboratory, it will be improved and en-

¹ J. C. Stearns, *The Scientific Monthly*, 46: 242-248, 1938.

larged to meet these requirements. Those wishing to use the laboratory this summer should communicate at an early date with Professor J. C. Stearns, University of Denver, Denver, Colorado.

J. C. STEARNS

GRANTS AWARDED BY THE AMERICAN PHILOSOPHICAL SOCIETY

THE committee on research of the American Philosophical Society, Philadelphia, made in February grants as follows:

Edward W. Berry, the Johns Hopkins University, for the illustrations of a study of the Tertiary flora of Cuba	\$ 100
Ralph E. Cleland, Goucher College, for continuation of work on cytogenetics and phylogeny of <i>Onagra</i> (evening primrose)	1,500
H. S. Jennings, the Johns Hopkins University, for the study of the cytology of ciliate protozoa, in particular the chromosomes and their behavior at conjugation in <i>Paramecium bursaria</i> and in other species of <i>Paramecium</i> ; also the chromosomes in the Opalinidae	1,200
Ernest W. Brown, Yale University, and W. J. Eckert, Columbia University, for the continuation of the verification of the polar coordinates which are used to predict the moon's place	500
William Berryman Scott and Glenn L. Jepsen, Princeton University, for the continuation of the monograph of White River Mammalia	600
Donald H. Andrews, the Johns Hopkins University, for the measurement of the heat capacities of nine or more organic compounds to be made in the range 1° to 300° K. together with supplementary measurements necessary to determine the values of the free energy and entropy at 300° K.	1,000
D. H. Kabakjian, University of Pennsylvania, for a study of the energy levels in pure or activated crystals and the dependence of these on physical structure	350
J. Kenneth Donahue, College of Charleston, for the study of the occurrence of hormones in marine invertebrates with special reference to the female sex hormone	500
Nabih Amin Faris, Princeton University, for the continuation of the editing from old manuscripts and translating into English the major work of al Ghazzali, the <i>Ihya 'Ulum al-Din</i> , which treats of Moslem theology and jurisprudence, Moslem political theory and constitutional law	500
Clarence E. McClung, University of Pennsylvania, for continuation of the project of bringing together as representative a group as possible of the short-horned grasshoppers for cytological, genetical and phylogenetic studies	400
Alexander Weinstein, Columbia University, for a	

historical, biological and philosophical study of human genetics	1,500
Robert Gaunt, New York University, for the study of the functional interrelationship of the adrenal cortex and the pituitary	500
Richard Krautheimer, Vassar College, for a historical and architectural analysis of the early Christian basilicas in Rome as far as preserved either completely or in remnants, fourth to ninth centuries	1,500
Wesley L. Bliss, University of New Mexico, for the study of evidence of early man in the area on the eastern flank of the Canadian Rockies to the Arctic and in the upper Yukon, with emphasis upon glacial and other geological and geographical conditions that may have influenced him	1,000
John H. Davis, Jr., Southwestern College, for the continuation of the study of mangroves and land building in southern Florida	425
Edwin Francis Carpenter, University of Arizona, for the study of the distribution of color in the extra-galactic nebulae	700
F. Martin Brown, Colorado College, for a study of the microscopic structure of animal hairs and the preparation of keys, drawings and description to be used in assisting in the determination of the various furs used by the aborigines of the southwestern states for making textiles, cords, etc.	600
Thomas Hale Ham, Harvard Medical School, for an investigation on the mechanism of blood destruction in normal and pathological conditions	1,500
Carl G. Vinson, University of Missouri, for a chemical investigation of disease viruses	500
Grants made in April, 1938, were as follows:	
Erwin K. Mapes, University of Iowa, to identify and collect the writings of the Mexican author, Manuel Gutiérrez Nájera, together with critical and other data regarding his life and work	500
J. J. Nassau and S. W. McCuskey, Case School of Applied Science, for the construction of a photoelectric machine for counting stellar images of varying degrees of brightness on a photographic plate	300
V. M. Slipher, Lowell Observatory, for the investigation of the spectrum of the light of the night sky	500
Dwight C. Carpenter, New York State Experiment Station, for the study of the effect of light on proteins and amino-acids	300
Ernst C. Abbe, University of Minnesota, for a detailed field study of the flora of the Richmond Gulf region (east coast of Hudson Bay) to gather further evidence concerning the interrelationship of historical and environmental factors in the floristic development of the Labrador peninsula	450
Leslie Spier, Yale University, for the completion	

of an extended ethnography of the Modoc Indians of Oregon	750
H. O. Burdick, Alfred University, for a continuation of studies of the physiology of the fallopian tubes	500
Samuel L. Leonard, Rutgers University, for the study of hypophysis-thyroid-gonad relationship	735
Harold S. Colton, Museum of Northern Arizona, to carry on archeological excavations in northwestern Arizona	1,000
Rudolf Höber, University of Pennsylvania, for a continuation of investigations on the secretory activity of the liver	1,200

EDWIN G. CONKLIN,
Chairman, Committee on Research

MEDALS OF THE FRANKLIN INSTITUTE

THE complete list of recipients in 1938 of the various medals awarded annually by the Franklin Institute, Philadelphia, Pa., as recommended by the Institute's Committee on Science and the Arts, has been announced as follows:

The Elliott Cresson Medal to Edwin H. Land, The Land-Wheelwright Laboratories, Inc., Boston, Mass., "in consideration of his contribution to the art and science of optics evidenced in his invention of polaroid and in his development of polaroid into a commercial product."

The Howard N. Potts Medal to Lars O. Grondahl, Union Switch and Signal Company, Swissvale, Pa., "in consideration of his recognition of the potential value of an accidentally discovered phenomenon in physics and of his subsequent masterly development of the principle involved into an extremely valuable engineering appliance, the copper-oxide rectifier."

The Louis Edward Levy Medal jointly to S. S. Kurtz, Jr., of the Chemical Section of the Sun Oil Company, Philadelphia, and A. L. Ward, of the Chemical Laboratory of the United Gas Improvement Company, Philadelphia, "for their series of papers on 'The Refractivity Intercept and the Specific Refraction Equation of Newton,' published in the *Journal* of the institute in November, 1936, November, 1937, and December, 1937."

The George R. Henderson Medal to Clyde C. Farmer, Westinghouse Air Brake Company, Pittsburgh, Pa., "in consideration of his invention and development of the 'AB' Freight Brake which has, in large measure, solved the difficulties and intricacies of a complicated problem in Railway Engineering."

The Walton Clark Gold Medal to Robert Brinton Harper, The Peoples Gas Light and Coke Company, Chicago, "in consideration of his leading part in the development, supervision and direction of a research and testing laboratory of outstanding excellence in the gas industry, his cooperation personally and through members of his staff with the gas industry generally, and his own distinguished work in the chemistry and physics of the gas industry."

The Edward Longstreth Medal to J. F. Hellweg, captain, U. S. Navy (retired), head of the United States

Naval Observatory, Washington, D. C., and to Paul Solenberger, Naval Observatory, Washington, D. C., "in consideration of their invention of a device combining a crystal controlled clock with a stroboscopic reading element and apparatus for emitting radio time signals, whereby the accuracy of these signals has been increased and the labor of preparing for their transmission reduced."

The Longstreth Medal jointly to Norman F. S. Russell, president, United States Pipe and Foundry Company, Burlington, N. J., and to Dr. Frederick C. Langenberg (deceased), "in consideration of the development of means for reducing the rate of cooling of iron pipe cast by the centrifugal process in externally cooled metal molds"; to Clarence W. Balke, director of research, Fansteel Metallurgical Corporation, Chicago, "in consideration of his scientific work in chemistry and metallurgy which resulted in the development of processes for the production and commercial utilization of Columbium and Tantalum."

As previously announced the Franklin Medals will be awarded to Dr. William Frederick Durand, professor emeritus of mechanical engineering at Stanford University, and to Dr. Charles A. Kraus, professor of chemistry and director of research in chemistry at Brown University.

The medals will be presented on Friday, May 20, in Franklin Hall, at the foot of the heroic white marble statue of Benjamin Franklin, sculptured by James Earle Fraser, which is to be unveiled on May 19. All recipients of medals will be guests of the Franklin Institute at the dedication banquet on Saturday, May 21, at 8:00 P.M., at the Bellevue-Stratford Hotel, when Mr. Hoover will make the address.

RECENT DEATHS

DR. MAURICE CROWTHER HALL, chief of the Zoological Division of the National Institute of Public Health,

U. S. Public Health Service, died on May 1 in his fifty-seventh year.

DR. WADE HAMPTON FROST, professor of epidemiology at the School of Hygiene and Public Health of the Johns Hopkins University, of which he was dean from 1931 to 1934, died on April 31 at the age of fifty-eight years.

DR. ROBERT TAIT MCKENZIE, J. William Wright research professor of physical education at the University of Pennsylvania, sculptor and physician, died on April 28 at the age of seventy years.

DR. ROSS V. PATTERSON, Sutherland M. Prevost professor of therapeutics and dean of the Jefferson Medical College, Philadelphia, died on May 2 at the age of sixty years.

DR. FRANCIS BAKER LANEY, since 1920 head of the department of geology at the University of Idaho, died on April 24 at the age of sixty-three years.

DR. JOHN M. BUCK, senior bacteriologist and assistant superintendent of the Federal Animal Disease Station at the Experiment Station at Bethesda, Md., died on May 2 at the age of fifty-nine years.

DR. LEWIS WEBB CRIGLER, surgeon director for ophthalmology of the Manhattan Eye, Ear and Throat Hospital, died suddenly on April 31. He was sixty-one years old.

Nature reports the death of Professor F. Mesnil, of the Pasteur Institute of Paris, member of the Section of Anatomy and Zoology of the Paris Academy of Sciences, aged seventy years, and of Professor Otto Naegeli, professor of internal medicine and director of the Medical Clinic in Zurich, known for his work on diseases of the blood, aged sixty-seven years.

SCIENTIFIC NOTES AND NEWS

DR. THOMAS PARRAN, surgeon-general of the U. S. Public Health Service, has been awarded the Mendel Medal of Villanova College, "in recognition of his scientific approach to the problems of public health."

THE George M. Kober Medal for distinguished service to medicine was presented on May 4, at the meeting of the Association of American Physicians held in Atlantic City, to Dr. Rufus Cole, member emeritus of the Rockefeller Institute for Medical Research, New York, formerly director of its hospital.

THE Howard Taylor Ricketts prize of the University of Chicago has been awarded to John Marshall Weir, Ph.D. (Chicago, '37), last year assistant professor of anatomy at the University of Mississippi, for his researches on long reactions on blood vessels. The

Ricketts prize was established in 1913 to honor Dr. Howard Taylor Ricketts, of the University of Chicago, who discovered the typhus germ and died a martyr to his discovery in Mexico.

THE annual dinner of the trustees of the American Museum of Natural History was given in honor of Dr. Frank M. Chapman, curator of the department of birds, who has completed a half century of service to the museum. An illuminated scroll was presented to him.

A SPECIAL feature of the thirteenth annual meeting of the Midwestern Psychological Association at the University of Wisconsin on April 22 and 23 was a golden anniversary dinner, at which Dr. Joseph Jastrow and Dr. Clark L. Hull were the guests of honor.

The dinner was given in celebration of the founding of the Psychological Laboratory at the university by Dr. Jastrow in 1888. Dr. Hull, now professor of psychology at Yale University, joined the university as assistant in 1914 and succeeded Dr. Jastrow as director of the laboratory. Professor V. A. C. Henmon, head of the department of education, was toastmaster. Dr. Jastrow spoke on "Stages in the Progress of Psychology," and Dr. Hull on "Adventures in Psychological Theorizing."

DR. ALEXANDER W. EVANS, Eaton professor of botany at Yale University, known for his work on the Hepaticae, will celebrate his seventieth anniversary on May 17. A dedicatory volume of *Annales Bryologici* is being prepared to mark the occasion. It will contain a biographical notice and portrait of Professor Evans together with about twenty-five contributions from leading American and European bryologists and hepaticologists.

SIR DAVID PRAIN has been appointed president for life of the Imperial College of Tropical Agriculture. *Nature* writes: "Sir David, who celebrated his eightieth birthday on July 11 last, was director of the Royal Botanic Gardens, Kew, from 1905 until 1922. He was a member of the Tropical Agricultural College Committee appointed by Lord Milner in 1919 and had been vice-chairman of the Imperial College of Tropical Agriculture from its foundation in 1921 until last year, when he retired. His appointment as life-president of the college is a particularly fitting honor which, it will be the general wish of all scientific workers, he may enjoy for some years."

THE Linnean Gold Medal of the Linnean Society of London for 1938 has been awarded to Sir D'Arcy Thompson, professor of natural history in the University of St. Andrews.

THE Hofmann Medal of the German Chemical Society has been awarded to M. Pierre Jolibois, professor of chemistry at the University of Paris.

At the meeting of the American Eugenics Society, held in New York City on May 5, Dr. S. J. Holmes, of the University of California, was elected president of the society, and Mrs. Shepherd Krech, president of the Maternity Center Association, New York City, was elected vice-president. Frederick Osborn is treasurer of the society.

MEMBERS of the faculty of the University of Minnesota who will retire at the close of the academic year include Dr. Anthony Zeleny, professor of physics, and Dr. Albert E. Jenks, professor of anthropology.

DR. EUGENE PAUL WIGNER, who resigned a year ago from the faculty of Princeton University to become professor of theoretical physics at the University of

Wisconsin, has been recalled to Princeton as Thomas D. Jones professor of mathematical physics.

At New York University, Assistant Dean William R. Bryans has been named chairman of the new department of engineering mechanics which will consolidate fundamental technical courses; Professor Lewis Van Carpenter has been appointed director of the new Sanitary Engineering Laboratory dedicated last autumn, and Professor Carlos de Zafra has been appointed curator of the James Arthur Collection of Clocks and Watches, to succeed Dr. Daniel W. Hering, who died on March 24.

DR. J. N. GOODIER, research fellow in applied mechanics since 1931 at the Ontario Research Foundation, has been named acting professor of mechanics in the Sibley School of Mechanical Engineering at Cornell University.

DR. GARRETT BIRKHOFF, of Harvard University, has been promoted to an assistant professorship in mathematics; Dr. John W. Green, of the University of California, and Dr. Donald T. Perkins, of Yale University, have been appointed Benjamin Peirce instructors in mathematics.

DR. ADOLF MAHR, director of the National Museum of Ireland and keeper of Irish antiquities, has been appointed Robert Munro lecturer in anthropology and prehistoric archeology for 1938-39 at the University of Edinburgh. This lectureship was founded in memory of Dr. Robert Munro, the Scottish archeologist.

J. EDGAR CRACKSTON, lecturer in physics at the University College of South Wales and Monmouthshire, Cardiff, will exchange positions with Professor Gwilym E. Owen, of Antioch College, for the academic year 1938-1939.

POL E. DUWEZ, of Brussels, has been nominated as head of the recently created National Laboratory for the Study of Silicates at Mons, Belgium. This laboratory, which is the only one of its kind in Belgium, will be not only a research center, but will also establish official specifications for all the products derived from silicates.

At the annual meeting of the Board of Trustees of the American Museum of Natural History on May 2, Dean Sage, Jr., and Malcolm P. Aldrich were elected members of the board. Mr. Sage led the West China expedition in 1934-35, and made extensive collections of mammals and birds. Mr. Aldrich, a director of the Commonwealth Fund, has been interested in the Hall of North American Mammals. He has also aided expeditions to Northern Mexico, Alberta and British Columbia.

COMMANDER DONALD B. MACMILLAN and a party of ten students will leave Boothbay Harbor, Me., on June

25 on the auxiliary schooner *Bowdoin* for his seventeenth Arctic expedition. It is planned to take moving pictures and to study the habits of Arctic birds and to map unknown harbors, the geology of Labrador and the advance and retreat of glaciers.

DR. LAUGE KOCH, the Danish explorer, on April 30 left by seaplane from Copenhagen for the Spitzbergen group of Norwegian Arctic islands with the object of ascertaining whether land exists between Spitzbergen and North Greenland. The Danish government has placed the vessel *Gustav Holm* at his disposal. The vessel will serve as a base of operations while Dr. Koch flies from Spitzbergen to Peary Land and back. If no land is sighted from the air a complete photographic survey will be undertaken from Peary Land.

DR. HARRY GOLDBLATT, professor of experimental pathology at Western Reserve University, will deliver the eighth Harvey Society lecture of the current series at the New York Academy of Medicine on May 19. He will speak on "Experimental Hypertension Induced by Renal Ischemia."

DR. B. M. DUGGAR, of the University of Wisconsin, addressed the Plant Institute of the Ohio Agricultural Experiment Station on the evening of April 27 on "Photosynthesis and Radiation."

DR. WILLIAM CROCKER, director of the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., lectured before the New York University chapter of Sigma Xi on May 6 on "The Effect of Anesthetics on Plants."

DR. OSCAR RIDDLE, of the Station for Experimental Evolution of the Carnegie Institution, gave an address on the evening of May 3 before the Lancaster, Pa., Branch of the American Association for the Advancement of Science on "What We Owe to Our Pituitary Glands."

DR. P. H. STEVENSON, associate professor of anatomy of the Peiping Union Medical College of Peiping, China, delivered in Stockholm the mid-year public lecture of the Geographical and Anthropological Society of Sweden on "The Paleogeographical Factors Involved in the Early Evolution of Man." The lecture was repeated by request in Copenhagen under the auspices of the Royal Geographical Society of Denmark.

DURING the summer session of 1938 at the University of Michigan, special emphasis will be given to the chemistry and metabolism of the proteins. During the first four weeks of the session, four guests will each present four lectures in their special fields of interest. The visiting lecturers will be Dr. R. Keith Cannan, professor of chemistry, New York University Medical College; Dr. Max Bergmann, member of the Rockefeller Institute for Medical Research; Dr. William C.

Rose, professor of biochemistry, University of Illinois; and Dr. Vincent du Vigneaud, professor of biochemistry, George Washington University Medical School. The lectures will be supplemented by lectures, discussions and laboratory work by the regular staff of the department of biological chemistry. Advanced courses will be open to graduate students and others. Information concerning this special program may be obtained from Dr. Howard B. Lewis, professor of biological chemistry, University of Michigan, Ann Arbor.

THE eighth Annual Research Conference of the Department of Chemistry of the Johns Hopkins University will be held from June 6 to June 17 at the Henlopen Hotel, Rehoboth Beach, Del. The first week will be on the subject of "Enzymes," with Dr. A. H. Corwin as chairman and will include lectures on their chemical nature and constitution, fermentation, catalysis and the mechanism of enzyme action, methods of assay of enzymes as well as some discussion of bacteriophage, insulin and filterable viruses. The second week will be on the "Mechanism of some Organic Reactions" with Dr. F. O. Rice as chairman. Certain general organic reactions, such as the Diels and Alder, Friedel and Craft, mercury and manganese salt catalysis, acid and base catalysis will be discussed especially in relation to polymerization. In addition one day will be devoted to the mechanism of heterogeneous catalysis. Further information may be obtained from F. O. Rice, department of chemistry, the Johns Hopkins University, Baltimore.

THE fifth annual convention of the Maryland Biology Teachers Association was held at the State Teachers College at Towson, Md., on April 23. The speakers included Dr. S. O. Mast, of the Johns Hopkins University; Dr. Margaret Reed Lewis, of the Carnegie Institution of Washington; Dr. Gairdner B. Mowbray, of Goucher College, and Dr. Paul S. Conger, custodian of diatoms, United States National Museum. The convention was well attended by both high school and college teachers and research workers. The annual research prize for the "greatest contribution to science on the part of a high school teacher of the state," was awarded to A. H. Bryant, instructor in Baltimore City College. Dr. Ernest N. Cory, professor of entomology in the University of Maryland, was elected president for the coming year, succeeding Dr. Mabel Lowell Bishop, of Hood College.

THE eighth annual field conference of Pennsylvania Geologists will be held in Maryland, West Virginia and Virginia on May 28, 29 and 30. The conference this year will be chiefly under the auspices of the Virginia Geological Survey. Dr. Arthur Bevan, state geologist, is local chairman. Field trips will embrace a study of the stratigraphy, structure, paleontology

and economic resources of Lower Paleozoic formations particularly in the Lower Devonian, Silurian, Ordovician, Lower Cambrian and Pre-Cambrian periods. A portion of the trip will be over the north half of the Skyline Drive. An optional trip to the Luray Caverns is included. The leaders will be Dr. Charles Butts, of the U. S. Geological Survey; Dr. Frank M. Swartz, of State College, Pennsylvania, and Dr. Arthur Bevan, state geologist of the Commonwealth of Virginia. The conference will assemble at the Algonquin Hotel, Cumberland, on Friday evening, May 27, for an evening conference and discussion. The second night will be spent in Winchester, Va., and the third in Luray, Va. Copies of the final notice and itinerary synopsis can be obtained by writing to Dr. Arthur B. Cleaves, *secretary*, Topographic and Geologic Survey, Harrisburg, Pa.

Nature writes that the Australian Government has decided not to proceed further at present with the proposal to invite the British Association to meet again in the Commonwealth. As it is desired, however, that leading men of science should from time to time be afforded opportunity to visit Australia, it has been decided to issue invitations to a party of six to attend the jubilee meeting of the Australian and New Zealand Association for the Advancement of Science at Can-

berra in January, 1939. It is hoped that the precedent so set will become regular practice at each succeeding biennial meeting of the association. A grant of £A1,500 towards the expenses of the guests in 1939 has been promised by the Government.

THE American Philosophical Society has been made the depository for a group of papers and memorabilia formerly belonging to the late Professor Elihu Thomson. In order to make the collection as complete as possible the society will be glad to receive additional contributions or information regarding such material. They should be sent to The American Philosophical Society, Philadelphia, Pa.

A CORRESPONDENT writes: "By the generous kindness of the widow and daughter of the late Sigmund Graenicher, a distinguished entomologist long resident in southern Florida, his collections of Diptera and Hymenoptera have been presented to the Museum of Comparative Zoology" at Harvard College.

THE John and Mary Markle Foundation of New York City has made a grant of \$10,000 for a three-year period to carry on research work on neurophysiology under the supervision of Dr. Ernst Gellhorn, professor of physiology in the College of Medicine of the University of Illinois.

DISCUSSION

ATTENDANCE AT SCIENTIFIC MEETINGS AND MEMBERSHIP POPULATION CENTER

ABOUT a year ago the center of membership population was determined for the American Association of Economic Entomologists and for the Entomological Society of America.¹ Continuing interest in the problem of selecting the best locations for meetings has led to a similar study with the membership of the American Association for the Advancement of Science. In this study the methods described in the article cited were used. The association membership by counties in continental United States was obtained from its summarized Proceedings as of late 1934. These were the latest figures readily available, but it is believed that changes in distribution since 1934 have not been great. These and other data used were supplied by the general offices of the association in Washington.

The membership distribution for the association was in general similar to that for the entomological societies, with heavy concentrations in the Middle Atlantic, lower New England, East North Central and

Pacific Coast States. A lower density was found westward and southward, especially in the sparsely populated Great Plains and Rockies. Membership of the association seemed to be more concentrated in large cities and educational centers than that of the entomological organizations, and was apparently less affected by horticultural development in the Gulf and Pacific States.

The "median," or place of crossing of the meridian and the parallel, dividing membership into halves, was located in the vicinity of Pittsburgh. The center of population, as determined by the gravity-center or first-moment method, was in eastern Madison County, Ind., about forty miles northeast of Indianapolis. These points are over 200 miles east and a little north of the same points for the combined entomological societies.

The winter meetings since the world war (1920-1936) of the American Association for the Advancement of Science were studied as to location and as to relation of registration to total membership. These factors are summarized below in comparison with those for the American Association of Economic Entomologists.

¹ F. M. Wadley, *Jour. Econ. Ent.*, 30 (4): 596-597, 1937.

TABLE 1
REGISTERED ATTENDANCE AT WINTER MEETINGS, 1920-36,
EXPRESSED AS PERCENTAGE OF MEMBERSHIP

Section	Number of meetings	Percentage of membership attending meetings	
		American Association of Economic Entomologists	American Association for the Advancement of Science
Middle Atlantic ...	6	22.7	25.4
New England	2	20.4	18.5
East North Central	3	22.8	19.8
West North Central	3	17.7	13.0
South Central	2	17.8	9.9
Canada	1	18.0	18.0

TABLE 2
AVERAGE ATTENDANCE AT ANNUAL MEETINGS IN VARIOUS
SECTIONS EXPRESSED AS PERCENTAGE OF AVERAGE
FOR MIDDLE ATLANTIC STATES. (CALCULATED
FROM TABLE ABOVE.)

Section	American Association of Economic Entomologists	American Association for the Advancement of Science
	Per cent.	Per cent.
Middle Atlantic	100.0	100.0
New England	89.9	72.8
East North Central...	100.4	78.0
West North Central...	78.0	51.2
South Central	78.4	39.0
Canada	79.3	70.9

Meeting places of the future will probably be selected on the basis of: (1) convenience of location; (2) facilities for large numbers of members; (3) rotation among important sections; and (4) cultural, scenic or general interest. The last two needs may be partly met by sectional or off-season meetings. Although there is a large membership on the Pacific Coast, it is worthy of note that a midwinter meeting has never been held there. It seems possible that, with present trends in automobile travel, winter meetings in the South might be well attended.

The facts studied show that, although entomological membership does not center very far west and south of association membership, a larger proportion of entomological society members than association members attend meetings in the western and southern sections.

F. M. WADLEY

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

STUDIES IN THE POTASSIUM METABOLISM OF THE ANIMAL BODY BY MEANS OF ITS ARTIFICIAL RADIOACTIVE ISOTOPE

A STUDY of the metabolism of potassium is being conducted on the white rat with the aid of radio-potassium used as a "tracer." Some of the salient facts which have been observed are given below.

The absorption of potassium from the gastro-intestinal tract is very rapid when potassium chloride is

administered to a normal adult fasted rat, about 90 per cent. being absorbed within half an hour. Some of the absorbed potassium is very quickly rejected, mainly through the kidneys. The major portion is retained and taken up by the muscles and other soft tissues of the body. The radio-potassium incorporated into the tissues displaces a certain proportion of the potassium previously there, and appears subsequently to have the same fate as the ordinary potassium present in the body.

After the first few hours, the potassium retention per gram of fresh tissue—called the "specific affinity"—is about the same for such varied tissues as muscle, liver, kidney, stomach, small intestines and heart.

Another point of interest is that the liver takes up a greater fraction of the radio-potassium when it is administered orally than when it is injected intraperitoneally. This may be explained if the predominant path of potassium absorption is via the portal system.

DAVID M. GREENBERG

MICHAEL JOSEPH

WALDO E. COHN

ELMA V. TUFTS

DIVISION OF BIOCHEMISTRY
UNIVERSITY OF CALIFORNIA
MEDICAL SCHOOL
BERKELEY

FOSSIL ALGAE FROM THE SALEM LIME- STONE OF INDIANA

SEVERAL years ago the writer briefly described and illustrated some peculiar "rod-and-bead" structures from the Salem limestone (Indiana building stone) of Indiana and suggested that they represented the castings of large worms.¹ This interpretation and one of the illustrations were included in "Invertebrate Paleontology," which appeared in the fall of 1935.² Since the Salem limestone has been used so widely for large state, federal and office buildings, extensive surfaces of the stone have been made available for examination; and it was hoped, therefore, that others who noted these peculiar structures, which show up clearly after the stone has weathered a few years, would scrutinize them carefully and test the validity of the suggested origin.

Late in 1935 Dr. Titus Ulke, of Washington, D. C., wrote to Dr. W. H. Twenhofel, calling attention to Fig. 43A in "Invertebrate Paleontology" and suggesting that the "rod-and-bead" markings were "... not worm castings and tracks, but *algae*, probably allied to ..." certain present-day lime-secreting forms.³ Several

¹ R. R. Shrock, *Proc. Ind. Acad. Sci. for 1934*, 44: 174-175, Figs. 1A-C, 1935.

² W. H. Twenhofel and R. R. Shrock, "Invertebrate Paleontology," McGraw-Hill Book Company, Inc., p. 137, Fig. 43A, 1935.

³ Letter to Dr. W. H. Twenhofel dated November 17, 1935.

years later the present writer sent a detailed description of the markings he had seen and examined to Dr. Ulke, who again asserted his belief that the structures should be referred to ancient algae. He emphasized the following points, which favor algal origin:

- (1) Where best developed the markings almost always lie flat with the bedding planes, *i.e.*, they lie parallel with the bedding planes.
- (2) The material inside the rods and beads is essentially like the surrounding granular limestone.
- (3) Rods and beads alike are separated from the surrounding rock by a tiny groove, suggesting that there was once some sort of "skin" or shell around them.
- (4) In some instances the rods bend back at an acute angle.
- (5) Some of the rods branch and some possess tiny structures resembling rootlets.
- (6) Small lobate markings associated with the "rod-and-bead" structures suggest the fronds of algae.
- (7) Rarely the beads decrease in size in one direction, as in a budding algal branch.
- (8) Transverse partition walls are indicated in some instances.

The present writer has checked most of the observations just listed and believes that the suggested origin warrants serious consideration. Interpreting these "rod-and-bead" markings as ancient algae would also be in accord with the environmental conditions which are thought to have prevailed during the deposition of the Salem limestone.⁴ It has been suggested that this limestone, at least that portion which is a coquina of macerated shell matter, was deposited as a clean calcareous sand in shallow water, having been previous to its deposition a dune or beach sand. In such an environment of deposition algae, such as those which are thought to have formed the "rod-and-bead" structures, may well have found conditions favorable for

the extensive growth suggested by the abundance of preserved fossils.

ROBERT R. SHROCK

DEPARTMENT OF GEOLOGY,

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE TREATMENT OF "SNIFFLES" IN THE RAT WITH SULFANILAMIDE

"SNIFFLES" or a form of pneumonia in the rat is responsible for a high mortality in all laboratory rat colonies. Recovery is rare, although a rat may linger on for months after the first symptoms appear. In other cases the disease progresses rapidly and causes death within a week. Because no effective treatment is known and because the disease is contagious, it has been a source of considerable loss, particularly in experimental studies in which the rat is tested over a long period of time.

Since sulfanilamide has been successfully used in severe infections in humans and in experimentally induced infections in animals, we decided to test its effectiveness in the treatment of this disease characteristic to the rat.

An experimental and a control group were used, the former being given 50 mg daily (varying slightly with the animal's weight) mixed in the food and the latter given the same care except for the omission of the sulfanilamide. Both groups contained cases in which the disease exhibited varying degrees of severity.

Of the fourteen rats in the experimental group, twelve permanently recovered, whereas two died. All the seven animals in the control group died after varying lengths of time. Prompt treatment with the drug resulted in the more rapid recovery.

No detrimental effects of the drug have appeared despite the fact that some animals received it daily for nearly two months. Detailed case studies will be reported later.

NORMAN R. F. MAIER

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

EFFECT OF OXYGEN LIGHT AND LACTO-FLAVIN ON THE OXIDATION OF VITAMIN C IN MILK

THE oxidation of ascorbic acid and of fat in milk is sensitive to variations in dissolved oxygen as well as to dissolved copper and exposure to light. Laetoflavin is the sole agent in milk responsible for the sensitivity of ascorbic acid to light.

A correlation has been found between the rate of oxidation of ascorbic acid in the dark and the production of a common flavor defect of milk resulting from the oxidation of the fat. The addition of 0.005 to 0.01 per cent. of ascorbic acid delays the development of

this oxidized flavor.¹ It is possible that a competition for dissolved oxygen between two distinct processes is involved.^{1,2}

Mattick and Kon,³ Kon and Watson⁴ and Kon⁵ have found that sunlight, more specifically the short waves of visible light, accelerates the oxidation of re-

E. R. Cumings, *Handbook of Indiana Geology*, Pt. IV, 1922, p. 504.

¹ P. F. Sharp, G. M. Trout and E. S. Guthrie, *Tenth Ann. Rpt. N. Y. State Assoc. Dairy and Milk Inspectors*, p. 153, 1936.

² L. Buruiana, *Biochem. Jour.*, 31: 1452, 1937.

³ A. T. R. Mattick and S. K. Kon, *Nature*, 132: 446, 1933.

⁴ S. K. Kon and M. B. Watson, *Biochem. Jour.*, 30: 2273, 1936.

⁵ S. K. Kon, *SCIENCE*, 85: 119, 1937.

⁴ E. R. Cumings, *et al.*, 30th Ind. Rept., 1906, p. 1199; J. W. Beede, *et al.*, 39th Ind. Rept., 1915, pp. 204-206;

duced ascorbic acid when milk is exposed in glass bottles. They have found that the action of light on ascorbic acid does not take place in the absence of dissolved oxygen. In view of the note by Kon⁵ it should be recorded that in the experiments previously reported by us,^{1,6} special precautions were taken to prevent undue exposure of the milk to light. The experimental samples were collected in brown glass bottles, the bottles were never exposed to direct sunlight, and they were stored in the dark. The extent to which the commercial samples were exposed to light before shipment to the laboratory was not known.

Since ascorbic acid solutions and dissolved oxygen are colorless, they do not absorb through heavy glass bottles the light which accelerates the oxidation of ascorbic acid in milk. The oxidation of pure solutions of ascorbic acid is insensitive to the accelerative effect of visible light. Therefore some secondary substance must be involved in the mechanism of the photochemical oxidation of ascorbic acid in milk. Lactoflavin had long been suspected of playing a part in the oxidative changes in milk, and the fact that it absorbs blue light led to experiments to see if lactoflavin was the intermediary in the accelerative effect of light on the oxidation of ascorbic acid. Martini⁷ found that certain dyes such as methylene blue, and lactoflavin, act as photosensitizers in the oxidation of ascorbic acid.

After lactoflavin and ascorbic acid have been destroyed by prolonged exposure of milk to sunlight, light no longer causes the photo-oxidation of additional ascorbic acid. Addition of lactoflavin restores the photochemical sensitivity. Sensitivity of ascorbic acid to light can also be prevented by removal of the lactoflavin by adsorption. The ascorbic acid, which is relatively high in mares' milk, is relatively more stable towards light, because mares' milk contains little or no lactoflavin.⁸

The effect of lactoflavin on the photochemical oxidation of reduced ascorbic acid was studied, using pure compounds and artificial light. The photochemical oxidation occurred between the approximate pH limits of 5 and 9.6, and was not accelerated by the addition of copper (Table I).

TABLE 1

			Per cent. ascorbic acid oxidized in 10 minutes (pH 5.8)
Light	Air	Lactoflavin	48
Light	Nitrogen	Lactoflavin	2
Light	Air	1
....	Air	Lactoflavin	1

⁶ P. F. Sharp, *SCIENCE*, 84: 461, 1936.

⁷ E. Martini, *Bull. Soc. Ital. Biol. Sper.*, 10: 1235, 1934.

⁸ R. A. Rasmussen, R. Bogart and L. A. Maynard, Private communication.

Some investigators, who have shown marked effects of pasteurization on the destruction of vitamin C, have wrongly attributed the major influence of the variation observed to the amount of oxygen present during the heating, whereas the amount of dissolved copper,⁴ amount of catalyst of enzyme-like nature,^{6,9} previous exposure to light⁴ and time of holding after pasteurization were perhaps of more significance. Variations in dissolved oxygen are of practical importance during subsequent holding, rather than during pasteurization. This has not been clearly recognized and controlled by previous investigators.

Our experiments have shown that milk from which the oxygen has been removed can be exposed to sunlight in clear glass bottles for considerable periods of time without any appreciable diminution in the amount of reduced ascorbic acid and without developing the true oxidized flavor. (Oxygen-free milk when exposed to sunlight does develop an off flavor of a different kind.) Furthermore, when stored in the dark for a week, even after 0.1 mg of dissolved copper per liter is added, the oxidized flavor does not develop, and there is no appreciable decrease in the amount of reduced ascorbic acid. Milk freed from oxygen was heated for 3 hours at 63° C. (145° F.) after the addition of 0.1 mg per liter of dissolved copper, with no appreciable oxidation of reduced ascorbic acid.

We have devised a simple procedure for satisfactorily freeing milk from dissolved oxygen. The milk is subjected to evacuating equipment capable of lowering the temperature of the milk about 10° C. by the water vapor removed. The water vapor sweeps out the oxygen dissolved in the milk. The reduced pressure may be applied to the milk immediately after pasteurizing, or the milk may first be cooled to about 30° C. or less, at which temperature foaming is reduced. If cooling by this method is carried too far or performed too slowly, the formation of gravity cream is not satisfactory because of the agitation after the fat globules have begun to cluster.¹⁰ If milk has been held cold for some time it should first be warmed to 40–45° C. before cooling to 30° C. for vacuum cooling, or the vacuum should be applied to the milk at a temperature near 10° C. to avoid churning.

This procedure, which we call vacuum cooling, removes some types of off flavors from the milk,¹¹ and we have some evidence that it lessens the cooked flavor of pasteurized milk. Simply applying the reduced pressure without the sweeping-out effect of the removal

⁹ E. Stotz, C. J. Harrer and C. G. King, *Jour. Biol. Chem.*, 119: 511, 1937.

¹⁰ H. C. Troy and P. F. Sharp, *Jour. Dairy Sci.*, 11: 189, 1928.

¹¹ E. S. Guthrie and F. V. Beck, Paper delivered before Eastern Div., Amer. Dairy Sci. Assoc., September 20, 1937.

of water vapor does not reduce the oxygen in the milk sufficiently to give the best results.

After vacuum cooling, the milk can be drawn continuously into ordinary milk bottles by vacuum bottling technique. Or the vacuum can be released and the greater portion of the milk withdrawn from the bottom of the evaporating tank, and run without contact with air into milk bottles by means of a filter tube which is small enough to maintain a column of milk, and which reaches to the bottom of the bottle. In this way only the surface of the milk comes temporarily in contact with the air, and such bottles when completely filled and capped are practically oxygen free and remain so.

The results given in Table 2 are typical of the effect of the removal of the oxygen when bottled milk is stored at 1-3° C. The reduced ascorbic acid was determined by direct titration.^{6,12} The numbers in

TABLE 2

	Mg reduced ascorbic acid per liter after holding:	
	3 days	7 days
Raw milk (fresh, 20 mg./liter)	14 (0)	2 (0)
Raw milk (vacuum treated)	19 (0)	19 (0)
Pasteurized, surface cooler	14 (3)	4 (3)
Pasteurized, vacuum cooled	20 (0)	20 (0)
Past., 0.1 mg.Cu/1., surface cooler . .	2 (4)	0 (4)
Past., 0.1 mg.Cu/1., vacuum cooled . .	20 (0)	20 (0)

parentheses represent the degree of intensity of the oxidized flavor, (0) represents no oxidized flavor, and (4) represents the maximum intensity.

If after a few days oxygen-free milk is shaken with air, then oxidation of the reduced ascorbic acid proceeds at the rate which is normal for the sample and its treatment if it had not been freed from oxygen.

Milk pasteurized by the holder method (63° C. for 30 minutes) is generally believed to be more susceptible to oxidative changes than is raw milk, although pasteurization exerts little accelerative effect on the oxidation of the reduced form of vitamin C.^{4, 6, 13}

By utilizing water vapor generated in the milk by vacuum distillation to sweep out the oxygen, and preventing reabsorption of oxygen, flavor defects due to oxidation can be avoided and the reduced ascorbic acid naturally present in the milk or added to the milk can be preserved. Pasteurized milk subjected to this treatment is much higher in ascorbic acid after holding than is untreated raw milk held for the same length of time, and is much less subject to flavor defects.

DAVID B. HAND
E. S. GUTHRIE
PAUL F. SHARP

CORNELL UNIVERSITY

¹² P. F. Sharp, *Jour. Dairy Sci.*, 21: 85, 1938.

¹³ G. Rundberg, *Acta Paediatrica*, 15: 357, 1933-34.

THE MODE OF ACTION OF SULFANILAMIDE AND PRONTOSIL¹

THE chemotherapeutic activity of sulfanilamide and Prontosil is now well established. There is general agreement as to their effectiveness in combatting a number of infections but little agreement as to their mode of action. Most workers consider, however, that their effectiveness as chemotherapeutic agents is not paralleled by their bacteriostatic and bactericidal action *in vitro*.

It has been suggested by a number of investigators and denied by others that these compounds stimulate phagocytosis. Bliss and Long,² as a result of their work on *Clostridium welchii* infections in mice, have presented evidence that sulfanilamide retards the rate of bacterial multiplication and suggest that its effectiveness is due to its bacteriostatic action *in vivo*; that is, the rate of multiplication of the bacterium is retarded or stopped. The phagocytes are then able to engulf the infecting agents.

The work of Gordon and Thompson,³ and others on artificial opsonins suggested to us the possibility that sulfanilamide and Prontosil might function in this capacity. Accordingly, the action of these drugs was determined by means of a technique for measuring their opsonizing power in leucocyte-bacteria mixtures. The technique, the details of which will appear in a later paper, consists in placing into small agglutination tubes constant amounts of ascending dilutions of the drug, suspensions of bacteria and appropriate quantities of leucocytes. Parallel control tests consisting of the diluent for the drug (buffered saline), bacteria and leucocytes were conducted in every instance.

All leucocytes used were obtained from guinea-pig blood and, unless otherwise indicated, were well mixed with fresh guinea-pig plasma at the time of use. At the end of 30 minutes incubation at 37° C. with intermittent shaking, thick smears were made from each tube and were stained by Wright's method. Although a variety of bacteria was used, only the results with hemolytic streptococci are here presented. All observations were made in the same manner: the first 50 polymorphonuclear neutrophils seen were counted, and the presence or absence of ingested bacteria, the number of bacteria phagocytosed, and the number of leucocytes taking part in the reaction were recorded.

Upon examination of these slides it was noted that the greatest degree of phagocytosis occurred in dilutions of 1/50,000 to 1/100,000 of both sulfanilamide and Prontosil, and that the percentage of cells taking

¹ Preliminary report.

² E. A. Bliss and P. H. Long, *Jour. Am. Med. Asn.*, 109: 1524, 1937.

³ J. Gordon and F. C. Thompson, *Brit. Jour. Exp. Path.*, 18: 390, 1937.

part in the reaction showed a marked increase over that of controls. In an attempt to analyze the significance of the various factors which might play a part, the leucocytes and the streptococci were treated in various ways before setting up the tests for phagocytosis. It was found (1) that when leucocytes were well washed of plasma, (2) that when the leucocytes were treated with varying dilutions of the drug and then well washed, or (3) that when the streptococci were treated with varying concentrations of the drug and then washed, no more phagocytosis occurred than in controls. It appears that serum or a factor in it is necessary to obtain the effect of the drug.

The protocol given is typical of the results obtained when sulfanilamide or Prontosil was used. These drugs

THE EFFECT OF VARYING DILUTIONS OF SULFANILAMIDE ON PHAGOCYTOSIS OF HEMOLYTIC STREPTOCOCCI

Dilution of drug	Number of cocci phagocytosed	Percentage of leucocytes taking part
1/1000	192	20 per cent.
1/10,000	246	32 " "
1/50,000	514	60 " "
1/100,000	296	48 " "
1/250,000	82	12 " "
Control	96	16 " "

clearly enhanced the phagocytosis of hemolytic streptococci *in vitro*. Fresh serum or plasma appeared to be necessary for the completion of the reaction. Not only did these drugs increase the number of bacteria phagocytosed per leucocyte but also the number of leucocytes taking part in the reaction.

While our work was in progress, a paper by Osgood⁴ appeared in which are reported results essentially the same as ours; he used bone-marrow cultures as leucocytic suspensions. He concluded that increased phagocytosis is due to a neutralization of the bacterial toxins by sulfanilamide and that the drug has no direct effect on either the leucocytes or bacteria. The increased phagocytosis in the extremely high dilution ranges that we observed compares very favorably with his findings.

Just how sulfanilamide enhances phagocytosis is not clear, but our results briefly reported here suggest that sulfanilamide or a serum-sulfanilamide complex acts as an opsonin.

ROBERT FINKELSTEIN

JORGEN M. BIRKELAND

DEPARTMENT OF BACTERIOLOGY,
OHIO STATE UNIVERSITY

INCREASE IN VITAMIN A ACTIVITY OF CORN CAUSED BY DOUBLING THE NUMBER OF CHROMOSOMES¹

A QUANTITATIVE gene action in corn has been demonstrated by comparing the carotinoid content of pure

⁴ E. A. Osgood, *Jour. Amer. Med. Assn.*, 110: 349, 1938.

¹ Cooperative investigation of the Division of Cereal

yellow diploid and tetraploid strains. Since tetraploid corn contains twice as many chromosomes as ordinary diploid corn, it was of interest to see what effect doubling the number of genes for yellow would have on the amount of pigment. The interesting possibility presented itself that the vitamin A activity of corn might be increased by formation of the tetraploid.

The diploid corn was found to contain 0.0267 ± 0.0004 milligrams and the tetraploid corn 0.0380 ± 0.0007 milligrams of carotinoid per gram of dry meal. These values are the means of seventeen analyses of the diploid and sixteen of the tetraploid together with their standard errors. Thus the doubling of the number of chromosomes and genes for yellow, resulted in an increase of 43 per cent. in the total carotinoid content per unit weight. There was the same percentage increase in vitamin A activity, since both the active carotinoids, beta carotin and cryptoxanthin, and the inactive zeaxanthin were increased to the same extent. Approximate measurements showed no difference in the density of diploid and tetraploid kernels. Hence the 43 per cent. increase per unit weight is also the increase in carotinoid content per unit volume.

The volume of the endosperm cells in the tetraploid yellow corn used in these analyses was approximately 3.5 times as great as the volume of the endosperm cells of the comparable diploid, as determined by direct measurements of cell dimensions in different regions of the endosperm. Because of this marked increase in cell size which resulted from chromosome doubling, the concentration of the genes per unit volume was actually less in the tetraploid than in the diploid, even though the individual cells of the former contained twice as many genes as did the cells of the latter. However, the amount of carotinoid per cell was five times as great in the tetraploid as in the diploid. In terms of gene concentration within the endosperm tissue, there was in the tetraploid 2.5 times as much carotinoid per gene as there was in the diploid. These proportional differences may be summarized as follows:

	Diploid	Tetraploid
Cell volume	1	3.5
Carotinoid per unit volume	1	1.43
Carotinoid per cell	1	5
Genes per cell	1	2
Genes per unit volume	1.75	1
Carotinoid per gene	1	2.5

The diploid and tetraploid strains of yellow corn selected for this study were produced by crossing the F_1 hybrid between an inbred line of Webbers Dent

Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, and the Departments of Botany and Dairy Industry, New York State College of Agriculture, aided by a grant from the Committee on Radiations of the National Research Council.

and Illinois A with an inbred line of Luces Favorite. Individual tetraploid plants induced in this three-way hybrid by the heat treatment technique of Randolph² were mass pollinated during two subsequent generations and from this tetraploid strain samples of grain from 10 ears selected at random were taken for analysis. Diploid sister plants of the original tetraploids were intercrossed in a similar manner for two generations to provide a comparable diploid strain for comparison with the tetraploid.

For the fractionation and determination of the carotinoids the procedure of Kuhn and Brockmann³ was adopted with certain modifications. The pigments were extracted directly from the corn meal with anhydrous methyl alcohol, saponified and fractionated

with petroleum ether. For determining concentration we used a photoelectric colorimeter equipped with Corning glass filters 428 and 585 and calibrated against standard solutions of crystalline beta carotin.

We attribute the observed differences between diploid and tetraploid yellow corn to quantitative rather than qualitative gene differences, since the comparison was made between strains having a common origin and an essentially identical genetic constitution. There is a possibility that tetraploid corn will be of practical importance due to its increased vitamin A activity.

L. F. RANDOLPH
DAVID B. HAND

CORNELL UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

SIMPLIFIED SCHAEFFER SPORE STAIN

BEGINNING students of bacteriology frequently find it difficult to follow the original Schaeffer¹ technique, which calls for heating a flooded slide over an open flame, without breaking the slide. Consequently, the following technique was first worked out for beginning students in bacteriology at the Agricultural and Mechanical College of Texas, and since then, over a period of time and with a variety of cultures, it has given better results than the technique originally described. In addition, the method of drying and the time of staining have been modified.

A simple, inexpensive steam bath, perhaps a tin can or beaker of proper diameter or a metal tray about three inches deep and two inches wide, on an asbestos centered wire gauze, is used to heat the slides.

(1) Smears, prepared from spore suspensions, are dried for staining by laying the slide on the table top near the base of the burner used for heating the steam bath.

(2) Dried slides are placed across the steam bath until definite droplets of water collect on the bottom of the slide.

(3) The slides are then flooded with 5 per cent. aqueous malachite green and left on the steam bath for one minute.

(4) Stained slides are removed from the steam bath with the thumb and index finger of one hand and dropped into cool water. This is done by spanning the length of the slide. The overhanging ends of the slides are cool enough to do this without danger of burns.

(5) The slides are thoroughly rinsed and, while still

wet, are counterstained with 0.5 per cent. aqueous safranin for thirty seconds and again rinsed in cool water.

(6) Rinsed and dried slides are easily examined under the microscope. As in the original Schaeffer staining technique, the spores stain green and the vegetative cells stain red.

GERALD K. ASHBY

MEAD JOHNSON & Co.,
EVANSVILLE, IND.

A METHOD FOR FIXING AND STAINING EARTHWORMS

NOTHING furnishes more satisfactory material for classroom work than sections of earthworms properly fixed and stained. In almost every course in general biology or zoology some time is devoted to the histological study of the common earthworm. It is unfortunate that the material used is often poorly fixed and the sections do not show up well. I have found the method given below simple, quick and one which gives excellent results.

Collect several earthworms and rinse off the dirt. Place these in a covered dish and sprinkle a small amount of well-sifted corn meal and powdered agar mixed in equal proportions on the bottom of the dish. Some finely chopped lettuce may also be added. Cover the worms with a moist paper and leave in a cool dark place. Transfer the worms to clean dishes and change the food each day for three days. By this time their alimentary tract should be free of all dirt and grit.

The specimens are fixed by cutting them into pieces about three fourths of an inch long and dropped directly into warm (about 50° C.) Allen's B-15. Fix for twelve hours and then rinse in water and run through 35, 50, 70, 80, 95 and two changes of 100 per cent. alcohol. Leave in each alcohol one hour. Now run

² L. F. Randolph, *Proc. Nat. Acad. Sci.*, 18: 222-229, 1932.

³ R. Kuhn and H. Brockmann, *Zeit. Physiol. Chemie.*, 206: 41, 1932.

¹ Alice B. Schaeffer and McDonald Fulton, *SCIENCE*, 77: 194, 1933.

through an alcohol-chloroform series as follows: One part chloroform to three parts of 100 per cent. alcohol, one hour; one part chloroform to one part alcohol, one hour; three parts chloroform to one part alcohol, one hour; pure chloroform, one hour. Saturate the chloroform with paraffin and leave twelve hours, add more paraffin and put in an oven at 58° C. for six hours. Pour off the liquid and add melted paraffin and leave in the oven for forty-eight hours, then embed and section at 12 microns.

Delafield's haematoxylin is a very satisfactory stain, since it shows up the tissues well and has the added advantage of being permanent. The sections should be stained from 10 to 30 minutes and then washed in water and destained in 50 per cent. acid alcohol (3 drops of HCl to 100 cc of alcohol) until the sections are a deep pink color, then wash in ammonia alcohol (5 drops of ammonia to 100 cc of 50 per cent. alcohol) until they are a light blue color. Run up and mount in dammar or balsam.

ELTON C. COCKE

UNIVERSITY OF VIRGINIA

GRASS VOLUME TABLES FOR DETERMINING RANGE UTILIZATION

FORESTERS have used tree volume tables for decades, but the authors know of no previous effort to develop volume tables for range grasses. There is an urgent need for a mechanical means of determining the degree of grazing of forage plants on national forests and other ranges in the West. The use of such tables offers a very promising aid in range research and in practical range inspection.

More than seven hundred samples of sixteen important range grasses have been collected, mainly from Montana national forests. The plants were cut and weighed to show the weight per inch of height, and tables have been prepared for each species. There appears to be very satisfactory correlation between weight and volume. A much greater concentration of weight exists in the lower portions than is generally known among range ecologists. In *Festuca idahoensis* approximately three fourths of the weight is in the lowest one fourth of height, and other species show similar distribution. The basic method was devised in 1927 by the senior author. Under his direction further development was made in 1934-35 by Chandler Jensen and Kenneth E. Chriswell, and the present form was completed in 1937-38 by Chandler Jensen and Adolph Hecht.

For determining utilization on grazed ranges a table was devised to convert inches of stubble remaining into percentage of height removed. The latter was then aligned with a percentage of volume utilization scale for the species concerned. Edward C. Crafts, of the

Southwestern Forest and Range Experiment Station at Tucson, Ariz., replaced the conversion table with a modified slide rule scale. In this region, we have now developed a partial three-cycle, semi-circular logarithmic scale which converts inches of stubble remaining directly into percentage volume utilization. A full account of this work will be published later.

TOM LOMMASSON
CHANDLER JENSEN

U. S. FOREST SERVICE,
MISSOULA, MONT.

BOOKS RECEIVED

- Actualités Scientifiques et Industrielles: 502, Nécessaire Mathématique*, MAURICE CURIE and MAURICE PROST. Pp. 112. 44 figures. 20 fr. 516, *Analogies Entre les Principes de Carnot, Mayer and Curie*, PAUL RENAUD. Pp. 45. 10 fr. 517, *Le Polonium*, M. HAISSINSKY. Pp. 43. 12 fr. 542, *Fluctuations en Densité*, J. YVON. Pp. 63. 18 fr. 543, *La Propagation et la Diffusion de la Lumière*, J. YVON. Pp. 133. 18 fr. 544, *Les Phénomènes D'Auto-Oscillation Dans les Installations Hydrauliques*, Y. ROCARD. Pp. 68. 13 figures. 18 fr. 547, *Contribution A L'Etude des Régions Ionisées de la Haute Atmosphère*, R. RIVAUT. Pp. 90. 39 figures. 20 fr. 549, *La Structure des Corps Solides dans la Physique Moderne*, LÉON BRILLOUIN. Pp. 53. 27 figures. 18 fr. 550, *Spectrographie de Masse*, J. ISOTOPES et Leurs Masses, LOUIS CARTAN. Pp. 90. 37 figures. 20 fr. 551, *Sur les Espaces a Structure Uniforme, et sur la Topologie Générale*, ANDRÉ WEIL. Pp. 39. 15 fr. Hermann, Paris.
- CASWELL, ALBERT E. *An Outline of Physics*. Revised edition. Pp. ix + 590. 373 figures. Macmillan. \$3.75.
- ECKSTEIN, OSKAR, ALBERT BRUNO and J. W. TURRENTINE. *Potash Deficiency Symptoms*. Second edition. Pp. xii + 235. 41 figures, 55 plates. Westermann. \$2.25.
- HOPKINS, ANDREW D. *Bioclimatics; a Science of Life and Climate Relations*. Miscellaneous Publication No. 280 of the U. S. Department of Agriculture. January, 1938. Pp. iv + 188. 55 figures. Government Printing Office, Washington.
- Internships and Residencies in New York City, 1934-1937*. Report by the New York Committee on the Study of Hospital Internships and Residencies. Pp. xxx + 492. The Commonwealth Fund. \$2.50.
- JACOBSON, EDMUND. *Progressive Relaxation*. Revised edition. Pp. xvii + 494. 89 figures. University of Chicago Press. \$5.00.
- LEA, C. H. *Rancidity in Edible Fats; Food Investigation Report No. 46, Department of Scientific and Industrial Research, Great Britain*. Pp. vi + 230. 38 figures. British Library of Information, New York. \$1.10.
- Report of the Low Temperature Research Laboratory, Department of Agriculture and Forestry, Division of Plant Industry, Capetown, June, 1935 to June, 1936*. Pp. 215. 33 figures. Government Printer, Pretoria, South Africa.
- SARTON, GEORGE, Editor. *Osiris; Vol. III, Part 2, 1937*. Dr. Solomon Gandz: *The origin and development of the quadratic equations in Babylonian, Greek, and early Arabic algebra*. Pp. 405-557. 8 figures. Saint Catherine Press, Bruges, Belgium.
- WESSEL, PAUL. *Physik für Studierende an Technischen Hochschulen und Universitäten*. Pp. xii + 514. Illustrated. Ernst Reinhardt, Munich. R. M. 4.90.
- WOODRUFF, LORANDE L. *Animal Biology*. Second edition. Pp. xiv + 535. 312 figures. Macmillan. \$3.75.
- WOOSTER, W. A. *A Text-Book on Crystal Physics*. Pp. xvii + 295. 108 figures. Cambridge University Press. Macmillan. \$4.00.